Final

Basewide VOC Groundwater Record of Decision

Former McClellan Air Force Base
Air Force Real Property Agency

McClellan, California

August 2007

DEPARTMENT OF THE AIR FORCE
AIR FORCE REAL PROPERTY AGENCY

MEMORANDUM FOR SEE DISTRIBUTION

AUG 07 2007

FROM: AFRPA Western Region Execution Center
3411 Olson Street
McClellan CA 95652-1003

SUBJECT: Final (Signed) Groundwater VOC Record of Decision (DSR# 1876)

1. Attached please find the Final (Signed) Groundwater VOC Record of Decision for your records. It has an assigned McClellan Deliverable Status Report (DSR) #1876-6, is categorized as a "primary" document, and is due on 6 August 2007. The effective date of this ROD is 1 August 2007, corresponding to the date the ROD was signed by EPA, Region 9.

2. If you have any questions, please contact Mr. Don Gronstal at (916) 643-3672, ext 211.

STEVEN K. MAYER, P.E.
BRAC Environmental Coordinator

Attachment:
Final (Signed) Groundwater VOC ROD

DISTRIBUTION LIST
Final Groundwater VOC ROD (Signed)

ADDRESS	NUMBER OF COPIES
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McClellan, California

August 2007

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Glossary and Acronyms

µg/L	micrograms per liter
Administrative Record File	The collection of all pertinent documents that support the final remedy decision for VOCs in groundwater and VOCs that threaten groundwater, located at the former McClellan Air Force Base.
AFB	Air Force Base
Air Force Real Property Agency (AFRPA)	A field-operating agency activated by the Secretary of the Air Force. The mission is to execute the environmental programs and real and personal property disposal for major Air Force bases being closed in the United States and manage other real property transactions for active Air Force bases.
Applicable or Relevant and Appropriate Requirements (ARARs)	Federal laws and regulations and more stringent State laws and regulations that apply or are determined to be relevant and appropriate to the remedy.
AST	aboveground storage tank
Base	former McClellan Air Force Base (or McClellan)
bgs	below ground surface
BRAC	base realignment and closure, a term adopted from the Base Realignment and Closure Commissions that recommend closure and realignment actions to be presented to Congress and the President.
CCR	California Code of Regulations
CFR	Code of Federal Regulations
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	Also known as the Superfund Law, legislation passed in 1980 that defines required responses to releases of hazardous substances and past disposal practices, many of which created inactive, hazardous waste sites. The act was extensively amended in 1986 by the Superfund Amendments and Reauthorization Act, which clarified the original law and added new provisions.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS)	A national computerized management information system that automates entry, updating, and retrieval of data and tracks site- and non-site-specific in support of the Comprehensive Environmental Response, Compensation, and Liability Act. It contains information on hazardous waste site assessment and remediation.
Contaminant of Concern (COC)	Substances selected for environmental cleanup based on (1) predicted impacts to surface water or groundwater resources, (2) concentration measurements above maximum contaminant levels, and (3) health risk posed by the contaminant.
DCA	dichloroethane
DCE	dichloroethene
DTSC	Department of Toxic Substances Control
EE/CA	Engineering Evaluation/Cost Analysis performed to evaluate the feasibility of a removal action.
EPA	United States Environmental Protection Agency
Exposure Pathways	Pathways that people can be exposed to chemical contaminants. Common pathways include breathing, ingestion, or absorption through the skin.
Feasibility Study (FS)	A study of a hazardous waste site that must be completed before a cleanup remedy can be chosen and implemented. The Feasibility Study identifies and evaluates alternatives for addressing contamination.
Groundwater	Underground water that fills pores between particles of soil, sand, and gravel or openings in rocks to the point of saturation. Where groundwater occurs in significant quantity, it can be used as a source of drinking water.
GWOU	Groundwater Operable Unit
GWTP	groundwater treatment plant
Institutional Controls	Administrative or legal mechanisms that protect property users and the public from existing contamination that continues to be present during use of a site.
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
IWL	industrial wastewater line
JTT	Joint Technical Team

Local Reuse Authority	Sacramento County's Department of Economic Development and Intergovernmental Affairs, Office of McClellan Base Conversion, is charged with the development and implementation of the Base Reuse Plan.
LUC	Land Use Covenant
maximum contaminant level (MCL)	The maximum concentrations of contaminants permissible in a water system delivered to the public.
McClellan	former McClellan Air Force Base (or Base)
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mgd	million gallons per day
ML	minimum level
MNA	Monitored Natural Attenuation
National Oil and Hazardous Substances Pollution Contingency Plan (NCP)	The Federal regulation that guides determination of the sites to be cleaned up under CERCLA. This plan also provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances in accordance with CERCLA and the Clean Water Act.
National Priorities List (NPL)	U.S. Environmental Protection Agency's published list of the highest priority hazardous waste sites in the United States for investigation and cleanup.
Non-volatile Organic Compound	As used in this document, any CERCLA hazardous substance other than VOCs. Examples relevant to this document include heavy metals, pesticides, semi-volatile organic compounds, and dioxins.
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
Oil Water Separator	A device, often in the form of a tank, that separates the majority of oil and grease from a wastewater stream by allowing it to float to the top while the water below is drained off.
OU	operable unit
PCE	tetrachloroethene
ppb	parts per billion

Preferred Cleanup Alternative	The Air Force's suggested cleanup method for the contaminated site.
Present-worth Cost	The amount of money that would need to be invested today to yield the funds required over the life of the alternative for capital and annual operation and maintenance costs.
Proposed Plan	A summary of cleanup alternatives for a contaminated site, including a preferred alternative and the reasons for its selection. This step is the community's opportunity to review and comment on all cleanup alternatives under consideration. The responses to the comments are presented in the Record of Decision. All changes from the Proposed Plan are explained in the Record of Decision.
QAPP	quality assurance project plan
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
Record of Decision (ROD)	A document explaining and legally committing the responsible party(ies) to the cleanup alternative(s) that will be used at a site. The Record of Decision is based on information and technical analyses generated during the remedial investigation, the feasibility study, and consideration of public comments and community concerns.
Remedial Investigation (RI)	A hazardous waste site study to examine the nature and extent of site contamination.
Responsiveness Summary	The section within the Record of Decision that summarizes comments received from the public during the public comment period, and provides lead agency responses to them.
Restoration Advisory Board	A board consisting primarily of members of the public. RAB members have the opportunity to review cleanup reports and provide advice to decision makers on investigation and cleanup matters. The RAB is a forum for the exchange of information among community members, regulatory agencies, and Air Force personnel.
RICS	Remedial Investigation Characterization Summaries
Risk Assessment	A study based on the results of the remedial investigation to determine the extent to which chemical contaminants found at a Superfund site pose a risk to public health and the environment.
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act of 1986

SGA	Sacramento Groundwater Authority
Shallow Soil Gas	Soil gas within 15 feet of the ground surface.
SIP	State Implementation Plan
Soil Gas	Air between soil particles, which may contain contaminants that have vaporized.
Soil Vapor Extraction (SVE)	A method of treating soil contaminants by extracting contaminated soil gas using perforated underground pipes connected to vacuum pumps.
SSWD	Sacramento Suburban Water District
START/STOP Process	The START evaluation is used to determine if an SVE system is needed to protect groundwater, and a STOP evaluation is used to determine if an existing SVE system can be shut down.
State Land Use Covenant (SLUC)	Written agreements restricting land use for protection of human health and the environment.
STLC	Soluble Threshold Limit Concentration
SWRCB	State Water Resources Control Board
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TTLC	Total Threshold Limit Concentration
Unrestricted Land Use	A designation applied to property that has been investigated (and possibly remediated) and found not to be contaminated, or not contaminated to a degree that requires that property use be restricted to preclude homes, hospitals, and schools.
UST	underground storage tank
vapor inhalation pathway	A pathway used in risk analysis in which contaminants in the soil volatilize into soil gas, migrate into buildings, and are inhaled by the occupants
volatile organic compound (VOC)	An organic compound containing carbon that evaporates (volatilizes) readily at room temperature.
WFA	Water Forum Agreement
WQO	water quality objective

SECTION 1

Declaration

1.1 Site Name and Location

Department of the Air Force
Air Force Real Property Agency
Former McClellan Air Force Base
McClellan, CA 95652
Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: CA4570024337

1.2 Statement of Basis and Purpose

The Basewide Volatile Organic Compound (VOC) Groundwater Record of Decision (ROD) presents the Selected Remedy for VOCs in groundwater at the former McClellan Air Force Base (McClellan or Base) in Sacramento, California. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA, 42 United States Code Section 9601-9675), and with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 Code of Federal Regulations (CFR) Part 300). The decisions documented herein are based on information contained in the Administrative Record file, which is available for review at McClellan. The Air Force and the United States Environmental Protection Agency (EPA) Region 9 jointly selected the remedy with concurrence of the State of California. All parties participated in the Joint Technical Team (JTT) formed to resolve technical issues related to the remedy selection.

This ROD addresses remedial actions for VOC contamination in the Groundwater Operable Unit (GWOU), including all portions of the VOC groundwater contaminant plumes above the cleanup levels, regardless of whether they are located within or outside the former base boundaries. Trichloroethene (TCE) is the predominant contaminant of concern (COC) in groundwater but there are 12 other VOCs with reported concentrations above maximum contaminant levels (MCLs) that are addressed in this document. This ROD also addresses VOC contamination in the vadose zone that threatens to migrate to groundwater. This ROD is supported by the 1999 Basewide VOC Feasibility Study (FS) (CH2M HILL, 1999) and the 2004 Addendum to the Basewide VOC FS (AFRPA, 2004c).

1.3 Assessment of Site

The response action selected in this ROD, Groundwater Extraction and Treatment with In Situ Soil Vapor Extraction (SVE) and Institutional Controls, is necessary to protect the public health or welfare or the environment from actual releases of hazardous substances resulting from industrial operations at McClellan. The groundwater is currently being remediated using groundwater extraction and treatment under the Interim Record of

Decision (IROD) and SVE systems have been installed previously as removal actions. Contaminated groundwater from McClellan is not being used as a source of drinking water.

1.4 Description of Selected Remedy

The Selected Remedy for VOC contamination at McClellan is Alternative 2B as described in the VOC FS (CH2M HILL, 1999) and the VOC Proposed Plan (AFRPA, 2004a). The remedy includes groundwater extraction and treatment combined with in situ SVE. Under the Selected Remedy, the existing groundwater extraction and treatment system, which started operation in 1987 and was subsequently expanded, will be used to clean up groundwater. As part of the selected remedy, treated groundwater is discharged to surface water. SVE systems will be used to remove VOCs from the vadose zone that threaten to migrate to groundwater. To-date, 14 SVE systems have been installed at McClellan; no additional systems are planned at this time; however, the existing SVE systems will be expanded and new systems installed, if elevated VOCs are detected in the vadose zone. The site-specific START and STOP processes (provided in Attachment 2) will be used to determine whether to install a system and when to optimize or discontinue operation of a system, respectively.

As specified in the 2001 Dispute Resolution (see Attachment 1A):

> The Record of Decision will state 5 parts per billion (ppb) as the cleanup standard for trichloroethene (TCE). The parties agree to proceed with cleanup as proposed by the Air Force until such time as 5 ppb is achieved in each plume, as defined by the Base Realignment and Closure (BRAC) cleanup team. At that point, the Air Force, in collaboration with the State and EPA Remedial Project Managers, agrees within 60 days to complete an analysis and prepare a report (using agreed upon models) which evaluate the technical and economic feasibility of continuing remediation until plume levels reach 2.3 ppb TCE. After the report is complete, the parties will have another 30 days to reach an agreement. If an agreement cannot be reached, the Air Force may shut off the wells and any party may use the dispute resolution provisions of the Federal Facilities Agreement.

While TCE is the primary COC, the selected remedy requires cleanup of all COCs to MCLs. The Selected Remedy also includes institutional controls to prevent human exposure to VOCs at concentrations above MCLs and to protect the integrity of the remedial systems and associated monitoring systems. For groundwater plumes that are onbase, the Air Force is responsible for implementing, maintaining, enforcing, reporting, and monitoring the institutional controls, before and after property transfer until the remedial action is complete and institutional controls are no longer necessary. The Air Force may contractually delegate the actions associated with institutional controls. Deed restrictions and State Land Use Covenants (SLUCs) will be established at the time of property transfer. For groundwater plumes that are offbase, Sacramento County has implemented a consultation zone by ordinance to review any new well installations, and west of the base Sacramento County and the City of Sacramento have implemented a prohibition area to prohibit well installations.

This remedy was selected because it will clean up the VOC groundwater plumes and VOC contamination in the vadose zone that threatens to migrate to groundwater at the site and because it minimizes residual risk. The Selected Remedy provides the best approach for cost-effective risk reduction.

1.5 Statutory Determinations

The Selected Remedy, Groundwater Extraction and Treatment with in-situ SVE and institutional controls, is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and uses permanent solutions and alternative treatment technologies to the maximum extent practicable. Carbon adsorption and oxidation are used for treatment of extracted soil gas from the SVE systems, and the extracted groundwater is treated using air stripping, carbon adsorption, and ion exchange. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (that is, reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because this remedy will result in hazardous substances remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory five-year review will be conducted in 2009 and every five years after, until the VOC ROD cleanup levels have been achieved, to ensure that the remedy is, or will be, protective of human health and the environment. This will be the third five-year review; the first five-year review was completed in 1999; the second was completed in 2004.

When MCLs have been achieved, only those restrictions needed to permit additional cleanup to 2.3 ppb of TCE will be retained until the additional cleanup has been achieved or a decision is made not to proceed to that cleanup level.

1.6 Data Certification Checklist

The following information is included in the Decision Summary (Section 2) in this ROD:

- COCs (Section 2.7.1 Table 2)
- Potential exposure pathways (Section 2.7.1 Table 2 and Figure 10)
- Description of the potentially exposed population (Section 2.6, and Section 2.7.1 Figure 10)
- Cleanup levels established for COCs and the basis for these levels (Section 2.7.1 Table 2)
- Current and reasonably anticipated future land use assumptions (Section 2.6)
- Estimated remedy costs and the number of years over which the remedy cost estimates are projected (Section 2.10 Table 4)
- Key factor(s) that led to selection of the preferred alternative remedy (Sections 2.9 and 2.10)

Additional information can be found in the Administrative Record file for this site.

1.7 Authorizing Signatures

This is the signature sheet for the VOC ROD – at McClellan AFB. The Air Force and EPA jointly select the remedies described in this ROD:

26 June 2007

KATHRYN M. HALVORSON
Director, Air Force Real Property Agency
U.S. Air Force

Date

8/2/07

KATHLEEN H. JOHNSON
Chief, Federal Facilities and Site Cleanup Branch
Region 9, U.S. Environmental Protection Agency

Date

California Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board (RWQCB) (the State) had an opportunity to review and comment on the Basewide VOC Groundwater ROD and their concerns have been addressed.

ANTHONY J. LANDIS, P.E.
Chief, Northern California Operations
Office of Military Facilities
Department of Toxic Substances Control
California Environmental Protection Agency

Date

1.7 Authorizing Signatures

This is the signature sheet for the VOC ROD – at McClellan AFB. The Air Force and EPA jointly select the remedies described in this ROD:

Kathryn M. Halvorson — JUL 2 2007

KATHRYN M. HALVORSON
Director, Air Force Real Property Agency
U.S. Air Force

Date

KATHLEEN H. JOHNSON
Chief, Federal Facilities and Site Cleanup Branch
Region 9, U.S. Environmental Protection Agency

Date

California Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board (RWQCB) (the State) had an opportunity to review and comment on the Basewide VOC Groundwater ROD and their concerns have been addressed.

Anthony J. Landis — 7-13-07

ANTHONY J. LANDIS, P.E.
Chief, Northern California Operations
Office of Military Facilities
Department of Toxic Substances Control
California Environmental Protection Agency

Date

SECTION 2

Decision Summary

2.1 Site Name, Location, and Brief Description

McClellan is located in Sacramento County, 7 miles northeast of downtown Sacramento, California (CERCLIS Identification Number CA4570024337). It comprises approximately 3,000 acres and is bounded by the City of Sacramento on the west and southwest, and the unincorporated areas of Antelope on the north, Rio Linda on the northwest, and North Highlands on the east. A location map is shown on Figure 1.

The predominant current land uses at McClellan are aviation, industrial, commercial, and residential. There are also open space areas, the largest of which is the West Nature Area (approximately 222 acres). Current and proposed land uses at McClellan do not differ significantly from the uses of the property by the Air Force while McClellan was an active military installation.

2.2 Site History and Enforcement Activities

McClellan was an active industrial facility since 1939. Operations changed from the maintenance of bombers during World War II and the Korean conflict to the maintenance of jet aircraft in the 1960s. Later, operations were expanded to include the maintenance and repair of communications equipment and electronics. Historical operations conducted at McClellan released contaminants that impacted the vadose zone and groundwater.

In 1995, the Congressional BRAC Commission recommended closure of McClellan; and on July 13, 2001, McClellan was closed as an active military facility.

On October 15, 1984, EPA proposed listing McClellan on the National Priorities List (NPL), which is EPA's list of the highest-priority sites for cleanup. McClellan was formally placed on the NPL on July 22, 1987. In 1989, the Air Force, EPA Region 9, and the California Department of Health Services signed an Interagency Agreement for the cleanup. The Interagency Agreement was implemented in 1990.

Since 1979, McClellan has been investigating environmental contamination resulting from past waste management and disposal practices. Since the discovery of VOCs in groundwater in 1979, McClellan has taken numerous actions to characterize the nature and extent of contamination, protect human health and the environment, and remediate the contamination. Among these actions are connecting 550 offbase residents to a municipal water supply and starting up the groundwater extraction and treatment system in 1987, installing SVE systems starting in 1993, and expanding the groundwater extraction and treatment system in three phases, as specified in the 1995 IROD (McClellan AFB, 1995). McClellan also evaluated various in-situ and ex-situ treatment technologies in groundwater as part of the Strategic Environmental Research and Development Program.

Figure 2 shows the locations of groundwater extraction wells previously installed and operating. Figure 3 shows the locations of the SVE systems installed as removal actions in accordance with the Basewide Engineering Evaluation/Cost Analysis for SVE, General Evaluation Document (McClellan AFB, 1993) and site-specific Engineering Evaluation/Cost Analysis documents.

2.3 Community Participation

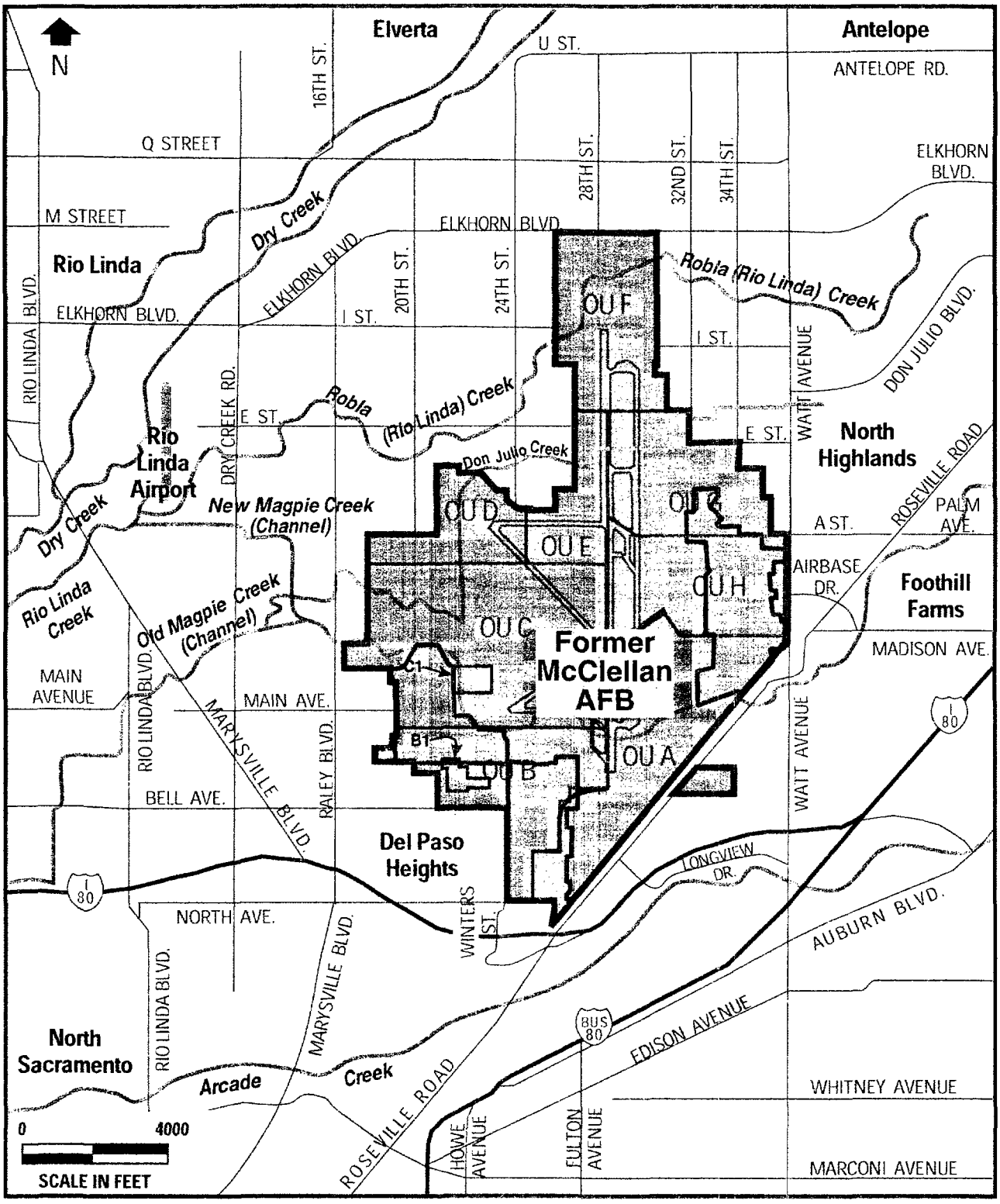
McClellan has had an active community relations/public participation program since the beginning of restoration activities in the early 1980s. The purpose of the program is to help community members understand McClellan's cleanup program and learn how to become involved in the cleanup decision-making process. Another reason the Air Force engages in this program is to obtain comments from the community on the cleanup process. The Air Force provides cleanup information through Restoration Advisory Board (RAB) and other public meetings, outreach briefings to community groups, training sessions, open houses, press releases and public notices, newsletters, fact sheets, and the Administrative Record file (http://www.afrpa.hq.af.mil/mcclellan/).

2.4 Scope and Role of Operable Unit or Response Action

For management purposes, McClellan has subdivided the Base into 11 operable units (OUs). Ten of the OUs correspond to discrete areas of the Base where specific industrial operations and/or waste management activities took place. Those OUs are designated A, B, B1, C, C1, D, E, F, G, and H. The other is the GWOU, which encompasses the entire Base. Refer to Figure 1, which depicts the various OU boundaries. Several documents, including the VOC FS Addendum (AFRPA, 2004c), the General Framework (Radian, 1997), and the Five-Year Review (MWH, 2004b), provide a more thorough discussion of background information at McClellan, including future RODs.

This ROD addresses remedial actions for VOC contamination in the GWOU, including both the groundwater itself and the threat to groundwater posed by contamination in the vadose zone that could migrate to groundwater. Contamination in groundwater from non-VOCs will be addressed through a Remedial Investigation/Feasibility Study (RI/FS) scheduled in 2007 and a subsequent ROD. All other VOC and non-VOC contamination in soil (including indoor air inhalation of VOCs) is being addressed through parcel-specific RODs. The Initial Parcel ROD 1 has been completed (AFRPA, 2004b); the completion of Initial Parcel ROD 2 is pending; the Focused Strategic Sites ROD will be completed in 2008; and the Initial Parcel ROD 3 is scheduled for completion in 2008. Other parcel-specific RODs will be completed until a remedy has been selected for soil contamination at all sites.

As discussed previously, the groundwater is currently being remediated using groundwater extraction and treatment under the IROD and SVE systems have been installed previously as removal actions. There have been two disputes between the Air Force and the regulatory agencies related to selection of the remedy for VOCs in groundwater at McClellan. These disputes were resolved in 2001 and 2005 and are discussed in greater detail in Sections 2.11.1, 2.12.2, and 2.13.



Works Consulted: Final McClellan AFB PEIS/EIR, July 1997; California State Automobile Association, Greater Sacramento, Northern Area, copyright 1993; Thomas Brothers Maps, The Thomas Guide, 1994 Sacramento County, copyright 1994.

FIGURE 1
LOCATION OF FORMER McCLELLAN AIR FORCE BASE
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

E092004009SAC_McClellan_AFB exhibit_3.fh10 09-29-04 dash

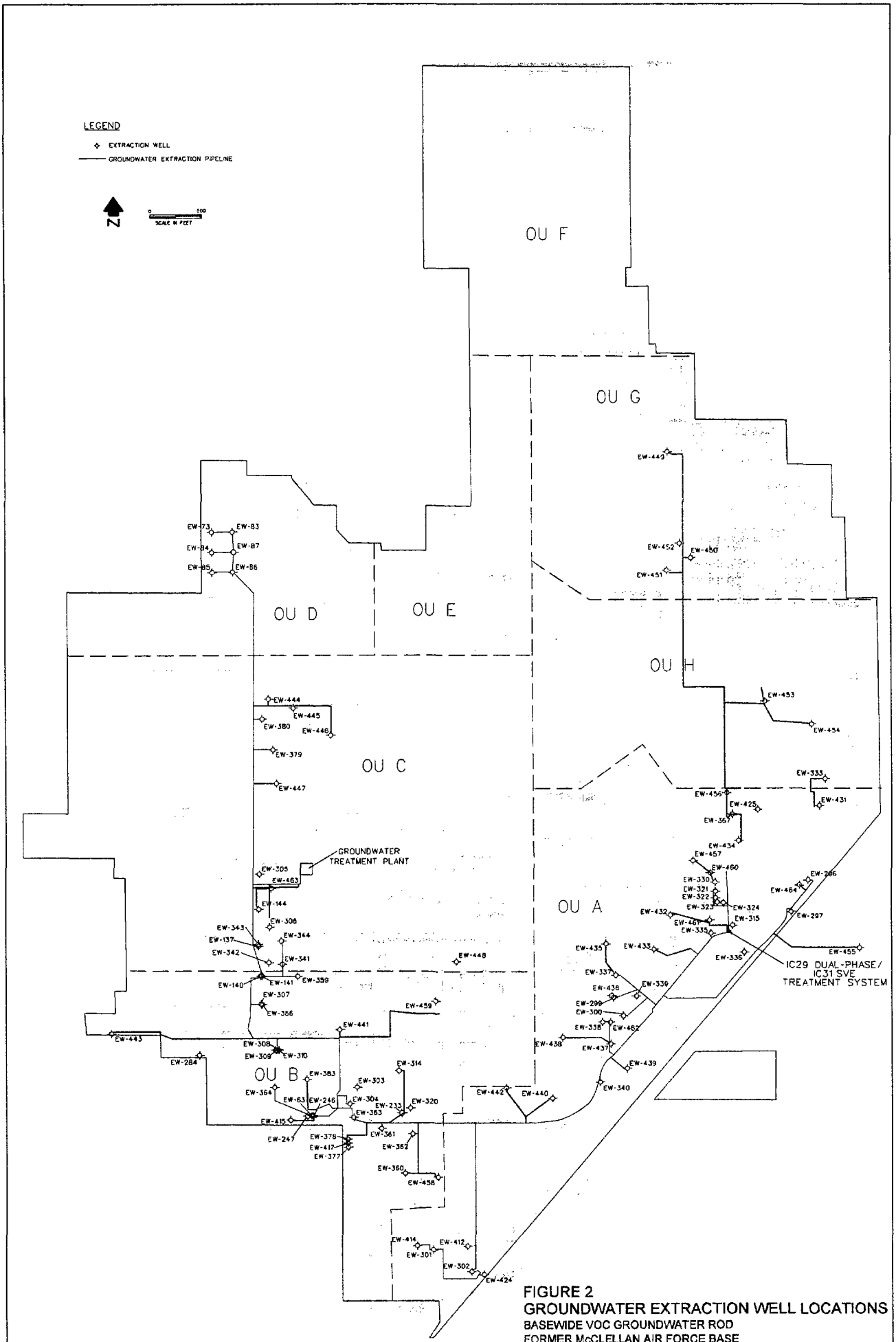


FIGURE 2
GROUNDWATER EXTRACTION WELL LOCATIONS
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

BWZONE_mod-2.dgn

2.5 Site Characteristics

The Air Force has extensively studied the contamination in the vadose zone and groundwater at McClellan. The studies found a variety of VOCs that have been designated as groundwater contaminants. VOCs are carbon-containing compounds that evaporate readily at room temperature. Most of the VOCs contaminating the groundwater at McClellan are degreasing compounds used in metal plating and electronics manufacture, and their degradation products. The most common VOC contaminants in the groundwater at McClellan are TCE, tetrachloroethene (PCE), cis-1,2-dichloroethene, 1,1-dichloroethene, and carbon tetrachloride.

Figure 4 shows the location of groundwater impacted by VOCs at McClellan. Locations where the vadose zone is contaminated with VOCs are shown on Figure 5.

A basewide conceptual model of the groundwater plumes and vadose zone contamination was developed during the remedial investigation (RI) process, and refined during development of the FS (CH2M HILL, 1999) and the FS Addendum (AFRPA, 2004c). Primary source areas for VOCs to surface and subsurface soils include sumps, disposal pits, fire training areas, waste lines, and washracks. Once in the vadose zone, VOCs volatilize as soil gas, sorb to soil particles, or continue to migrate predominantly through processes of advection or diffusion through the vadose zone into the saturated zone. In groundwater, VOCs are transported by lateral and vertical movement of the groundwater. At McClellan, the general groundwater flow direction is to the south-southwest. Vertical gradients can change significantly due to the variability in seasonal recharge and pumping. From before the Base was constructed until the late 1990s, the regional water table elevation declined dramatically (often at a rate of 1 foot per year) from regional pumping. As the water table dropped, contaminants remained adhered to soil, dissolved in residual pore water, or remained present in soil gas, leaving behind a smear zone. Since 1995, the rate of groundwater decline has decreased, and in some wells groundwater elevations have been rising approximately 0.5 feet/year since 1997. The conceptual model is described in detail in Section 1.3 of the FS (CH2M HILL, 1999) and in Section 3.0 of the FS Addendum (AFRPA, 2004c).

The RIs for the individual sites at McClellan have been conducted over the last 20 years and have been generally organized by OU. The RIs frequently included the collection of groundwater samples. The results and recommendations within each OU have been documented in Remedial Investigation Characterization Summaries (RICS) and are presented by OU. The GWOU RI/FS was completed in 1994 (CH2M HILL, 1994) and aggregated all groundwater results in one GWOU. Additional investigations of onbase and offbase groundwater contamination were completed during the implementation of the GWOU IROD (McClellan AFB, 1995), and, include the most recent Phase III Data Gaps Investigation Reports (MWH, 2003 and 2004a).

The first onbase and offbase monitoring wells were installed in 1984, followed by a carbon treatment system at Base Well-18 and a groundwater extraction and treatment system at OU D in 1987. The groundwater extraction and treatment system was expanded in three phases to achieve the objectives of the 1995 GWOU IROD.

2.6 Current and Potential Future Land and Water Uses

Figure 6 shows current land uses at McClellan. Onbase land use is a combination of open grassland, aircraft industrial, heavy and light industrial, warehouses, office buildings, and residential.

Currently, most of the industrial facilities are located in the southeast portion of the Base. The southwest portion has both industrial and storage areas. The far western part of the Base has areas of environmentally sensitive vernal pools and wetlands. Between these wetlands and the taxiways, there is an open area, historically used for disposal pits, and a series of engine test cells. Generally, aircraft parking areas and wash racks were located in the northeast area of the Base. Although specific future land uses are not known with certainty, the framework for reuse and redevelopment of the Base has been established. Future land use is expected to change only slightly from its current use (refer to Figure 7). For example, the currently designated residential area to the northeast and the open space located in the south will likely be used for office space. The open space preserve area to the west will remain largely unchanged, and office and heavy industrial uses will be concentrated in the eastern section of the Base. In general, future land use will probably include like or similar use of Base property, facilities, and infrastructure.

Most of the McClellan property will be subject to the planning and zoning authority of Sacramento County. The exception is a small area on the west-central periphery that lies within the jurisdiction of the City of Sacramento.

In the mid-1980s, groundwater use prohibition areas were created by Sacramento County (Well Ordinance Section 6.28.025) and the City of Sacramento (Ordinance 86-080 C and D). These areas represent a conservative estimate of how far the McClellan groundwater contamination plume could have moved away from McClellan, assuming a south- to southwesterly flow direction. Groundwater monitoring results have shown that the plumes to the west of McClellan are within the prohibition areas. To minimize any potential impact to human health from contaminated groundwater, McClellan connected residents within these areas to municipal water supplies in the 1980s. Figure 8 shows the prohibition areas, along with the current outline of the contaminant plumes. Current water use on the Base has been limited to one production well located on the eastern side of the base used for fire fighting purposes.

Future use of groundwater is restricted and use restrictions are described in greater detail in the Final Basewide VOC FS Addendum (AFRPA, 2004c). Figure 9 shows the approximate location of the 2,000-foot consultation zone around the contaminated plumes established by Sacramento County Well Ordinance Section 6.28.000G. Subsequent to establishing the prohibition area, groundwater contaminant plumes that are not part of the prohibition area were identified beyond the southeast boundary of McClellan; however, these contaminant plumes are part of the consultation zone. Any application for a well permit within this zone is subject to special review by appropriate regulatory agencies to evaluate potential impacts to public health and groundwater quality. For locations also within the prohibition areas described above, the prohibition on well installations takes precedence over the consultation zone, i.e., installation of any well proposed in the prohibition zone, regardless of whether the well would also be located in the consultation zone, is prohibited.

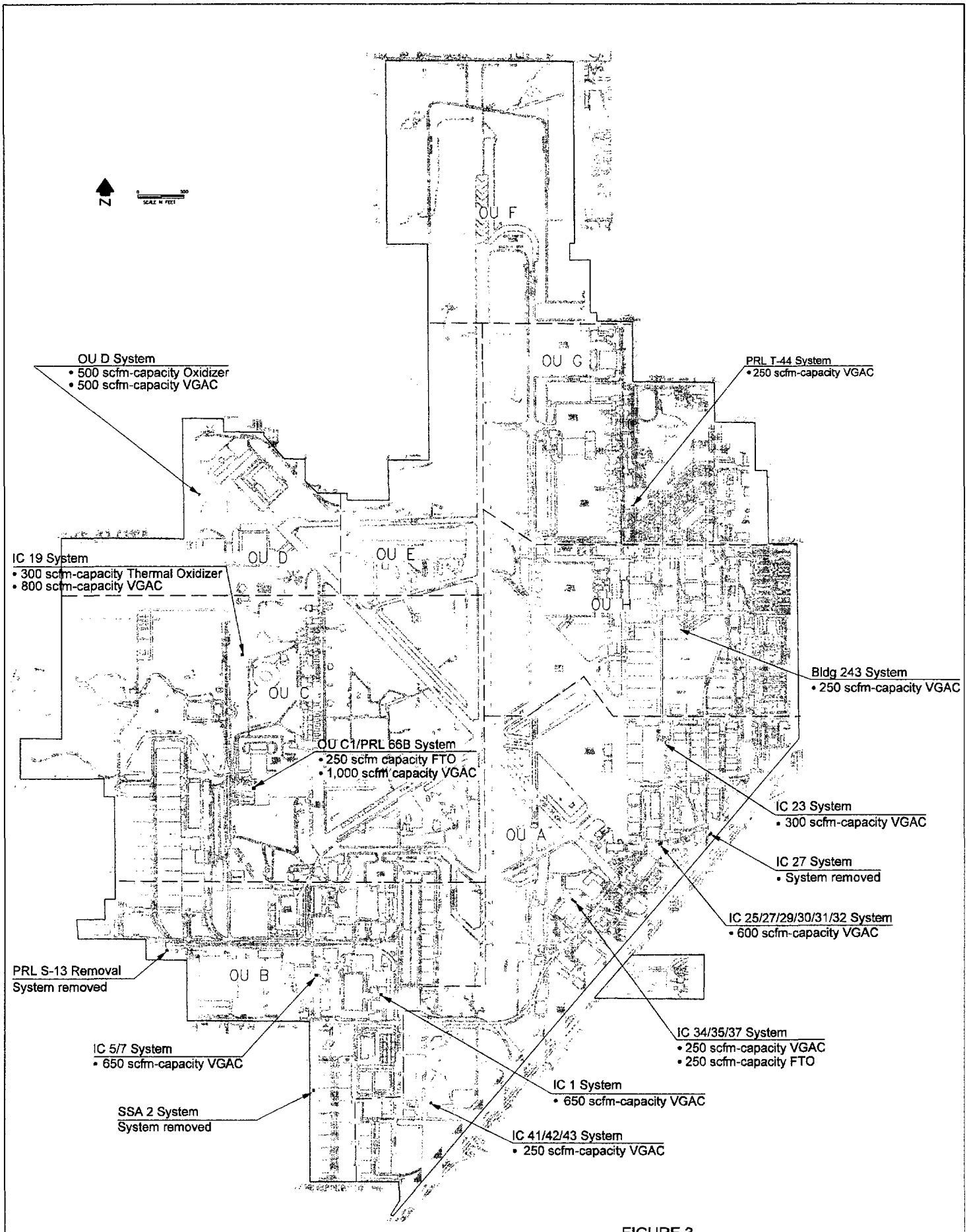
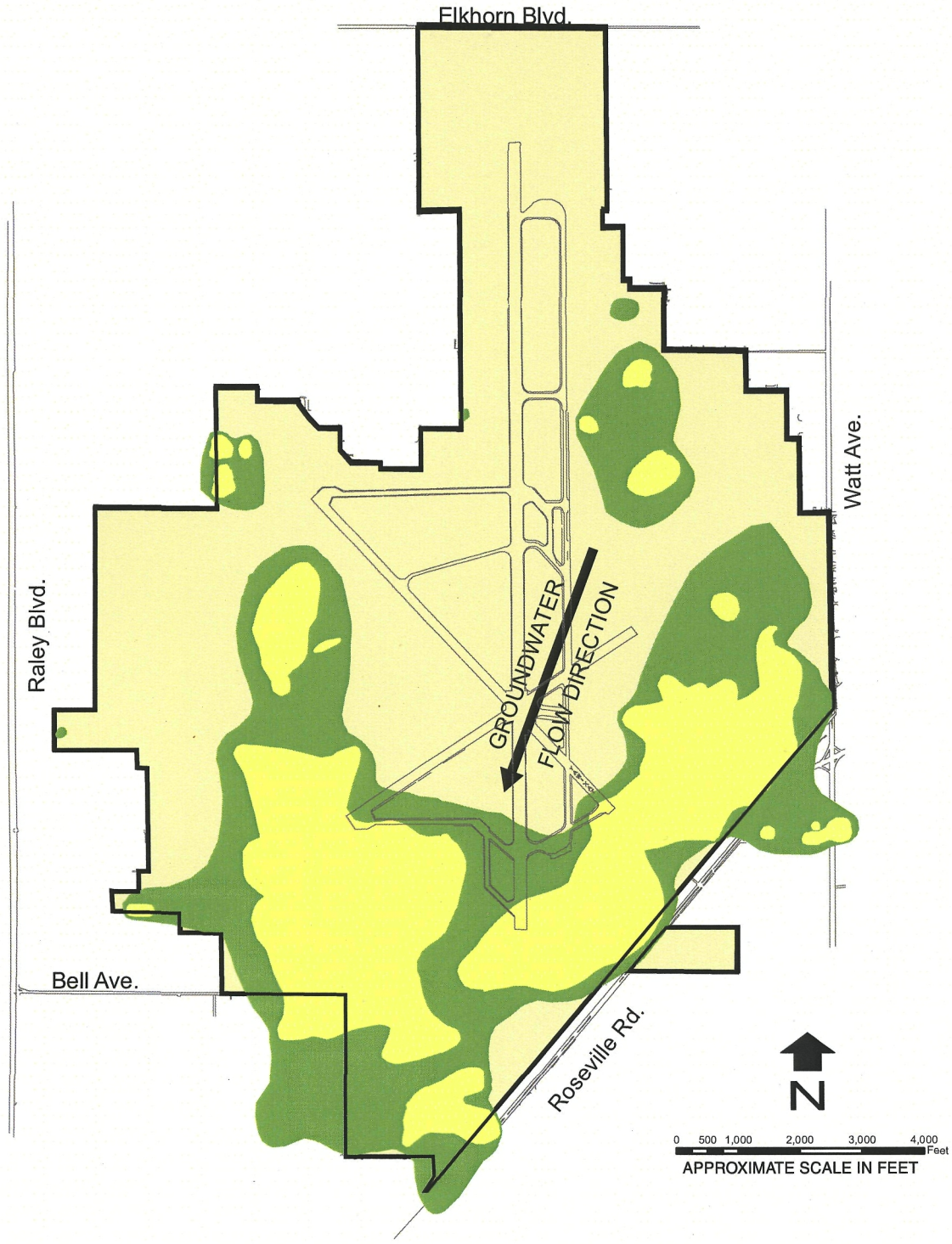


FIGURE 3
SVE TREATMENT SYSTEM LOCATIONS
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

SVE_system_mod.dgn



Legend

- Contamination below drinking water standards
- Contamination above drinking water standards

FIGURE 4
LOCATIONS OF VOCS IN GROUNDWATER
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

ES082006001SAC mcclellan_voc_figure_4.ai 08-22-06 tdaus

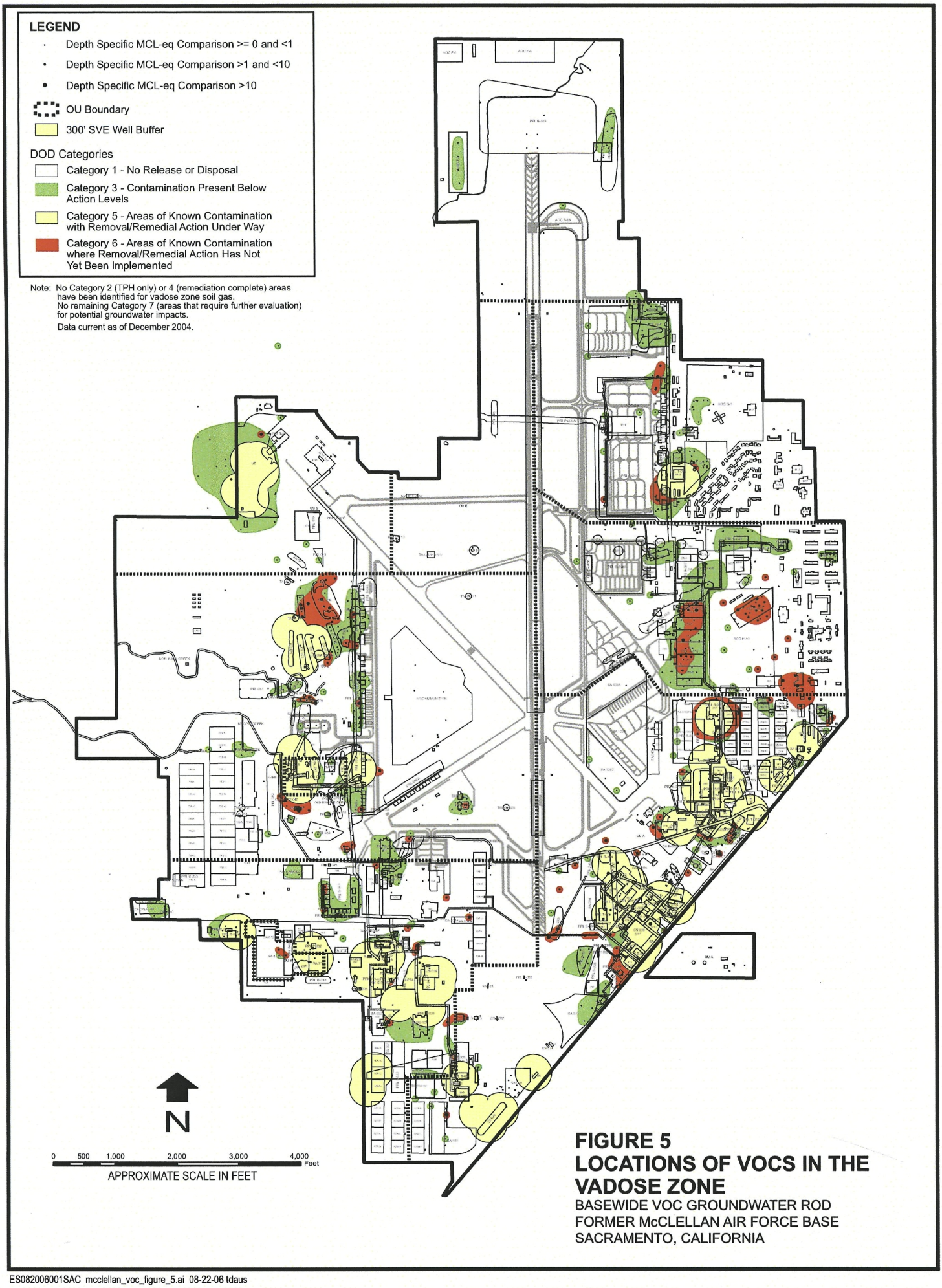


FIGURE 5
LOCATIONS OF VOCS IN THE VADOSE ZONE
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

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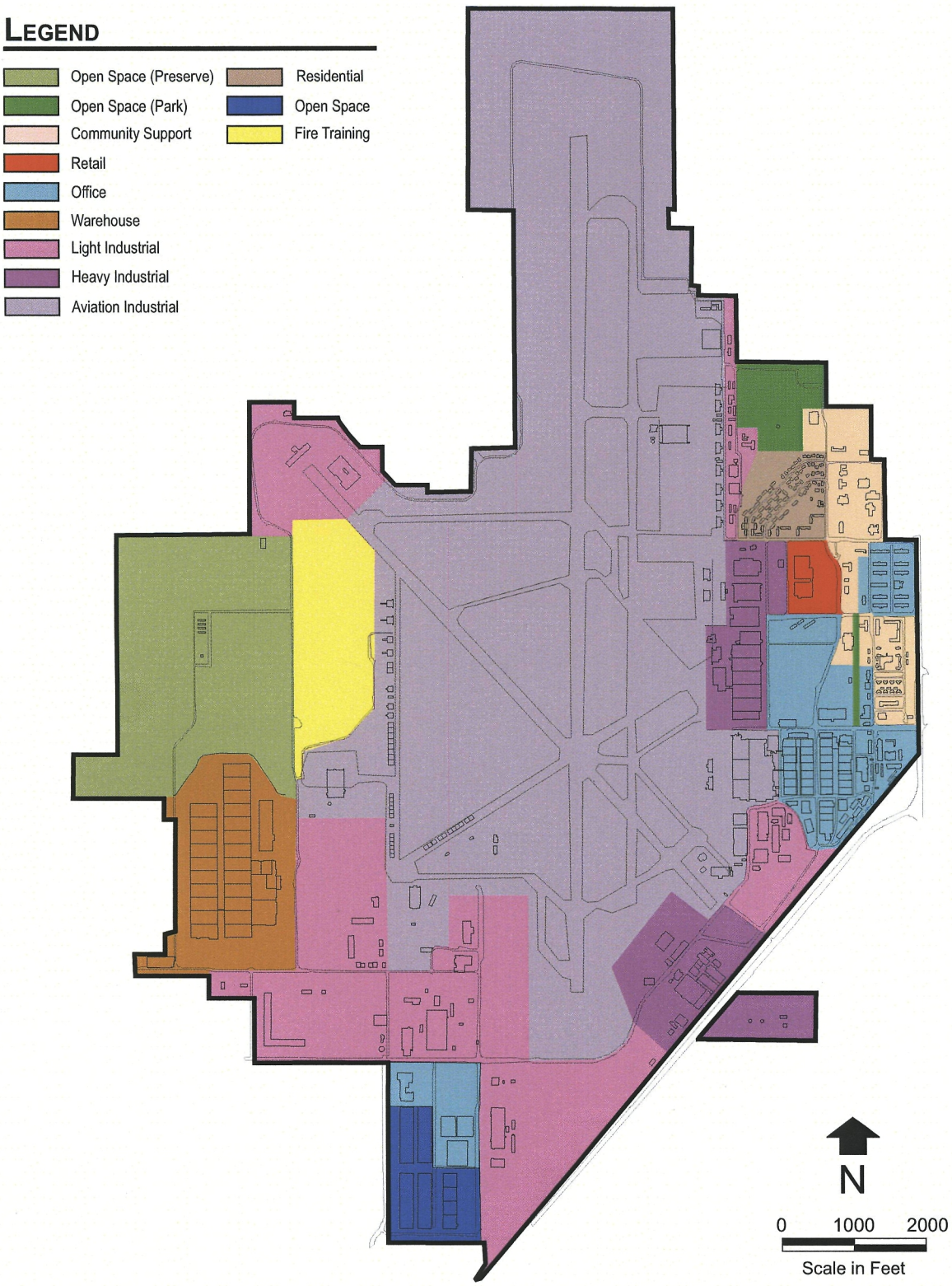


FIGURE 6
CURRENT LAND USES
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

ES082006001SAC mcclellan_voc_figure_6.ai 08-30-06 tdaus

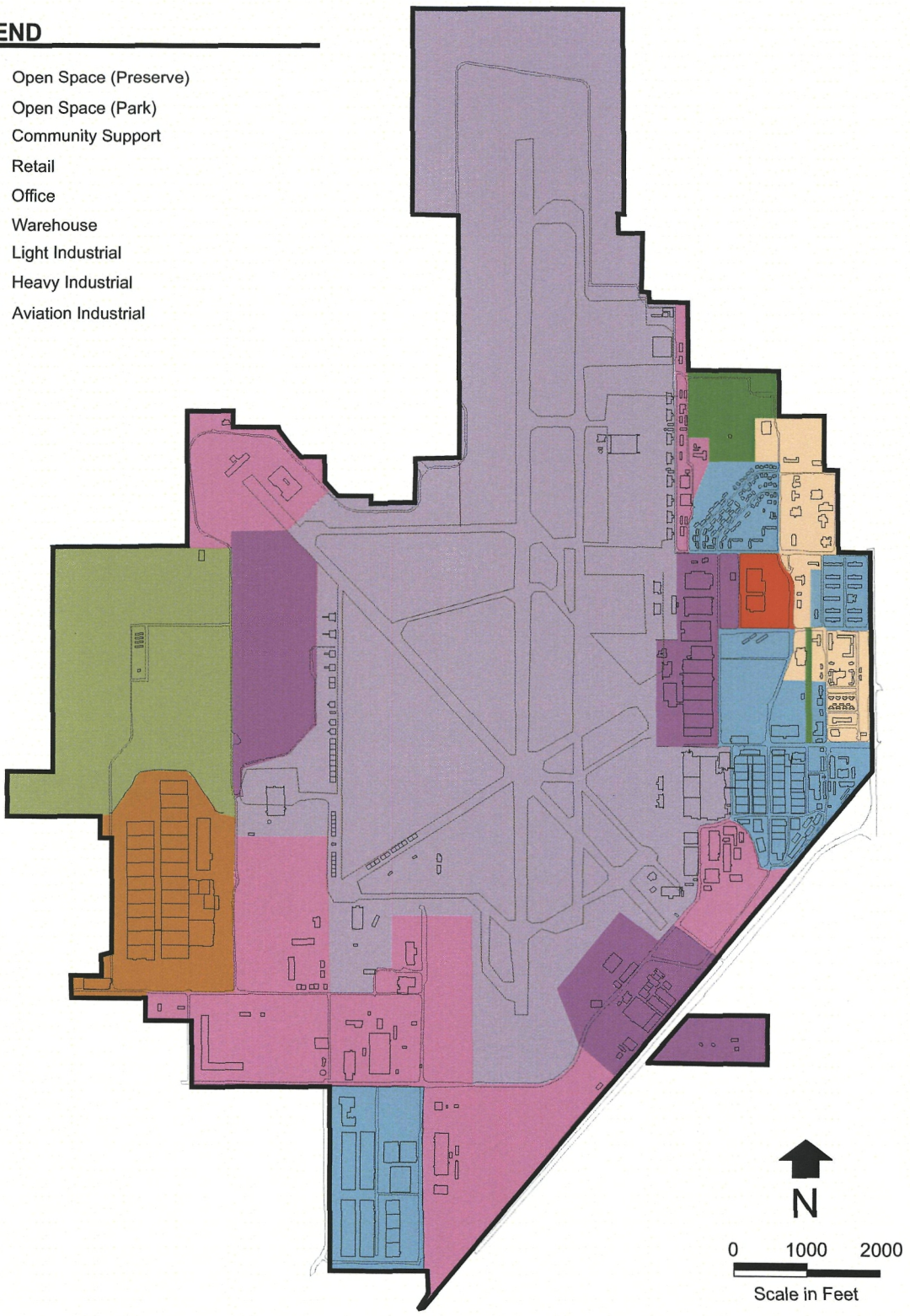


FIGURE 7
PLANNED LAND USES
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

ES082006001SAC mcclellan_voc_figure_7.ai 08-30-06 tdaus

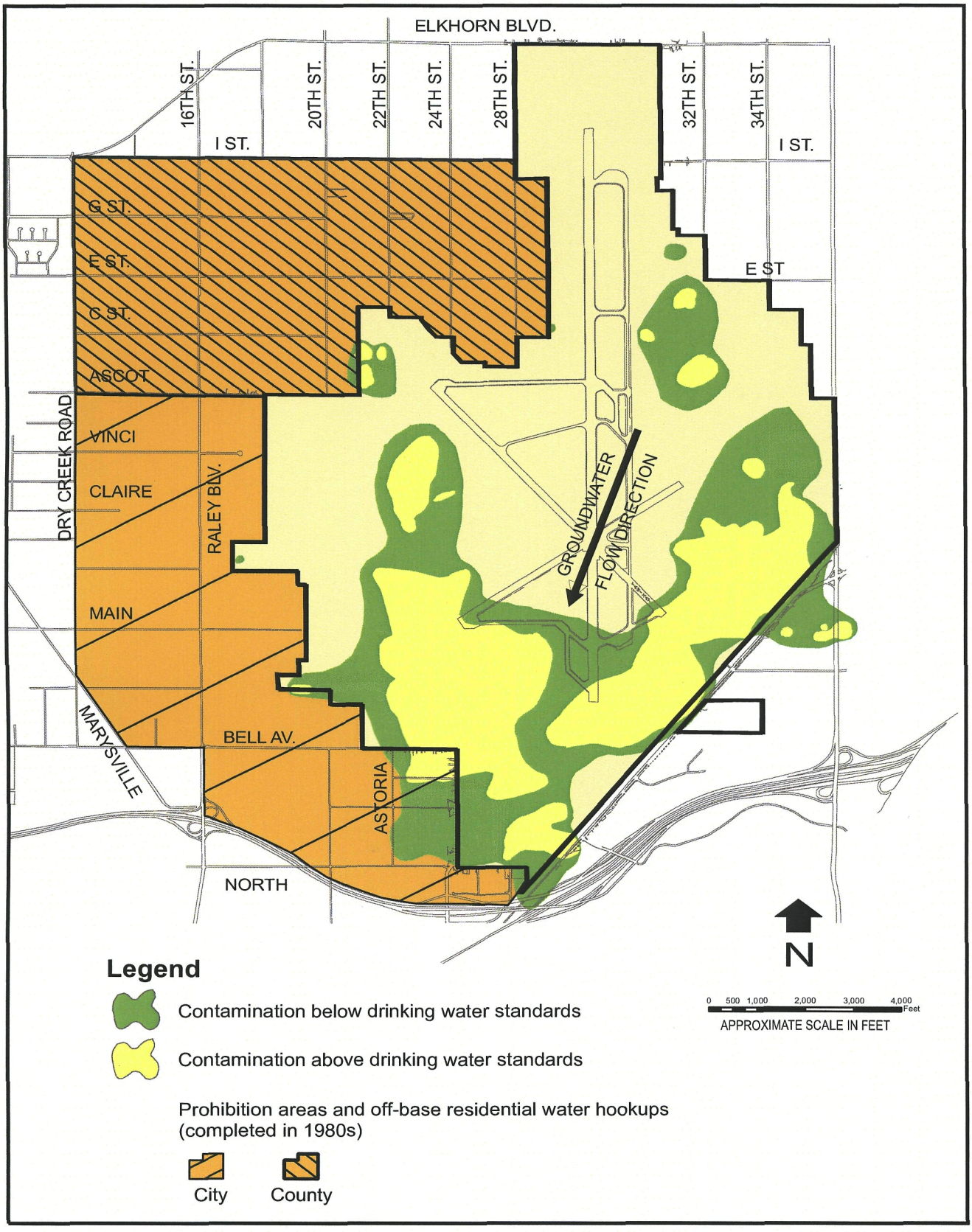


FIGURE 8
GROUNDWATER
PROHIBITION AREAS
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

ES082006001SAC mcclellan_voc_figure_8.ai 08-23-06 tdaus

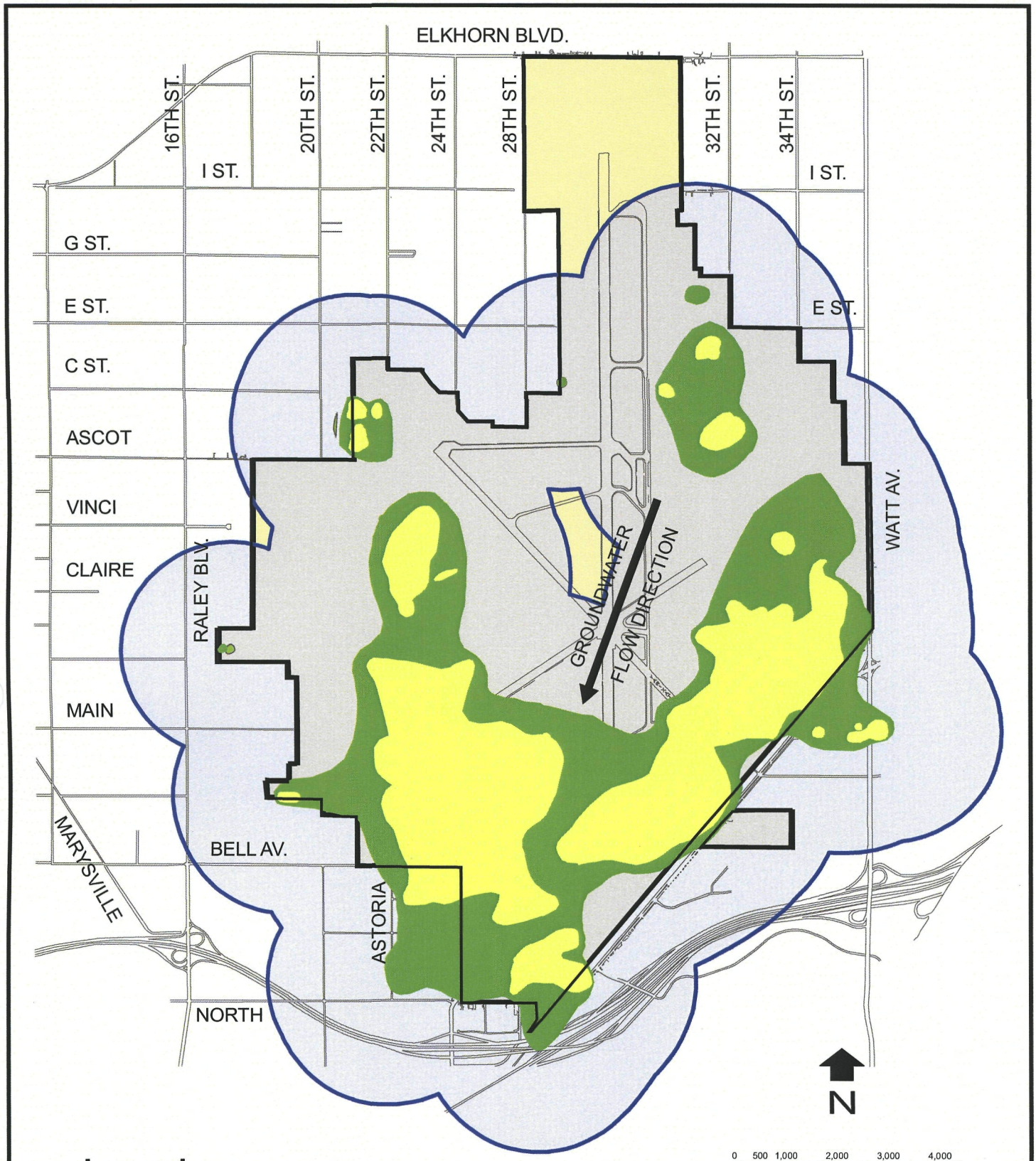


FIGURE 9
COUNTY GROUNDWATER CONSULTATION ZONE
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

ES082006001SAC mcclellan_voc_figure_9.ai 08-22-06 tdaus

2.7 Summary of Site Risks

The Air Force conducted a detailed evaluation to identify contaminants (and their respective concentrations in the vadose zone and groundwater) that could potentially produce adverse effects on human health. The results of the evaluation indicate that TCE is the most frequently detected contaminant. Figure 10 presents a summary of the conceptual site model, considering source areas, release mechanisms, exposure pathways and human/ecological receptors. Site-specific estimates of the potential risks to human health were provided in the RICS or site-specific FSs. Because of the large number of sites at McClellan, these risk estimates are not summarized here. However, a description is provided in Section 2.7.1 of the magnitude of the residual risks when the MCLs are achieved and of the potential risks to human health from current concentrations of contaminated groundwater.

The remedy and proposed cleanup levels are to be applied basewide. Table 1 is a list of sites where VOCs have been detected at concentrations and distributions that suggest that they could impact groundwater.

2.7.1 Human Health Risks

The excess lifetime cancer risks and non-cancer hazard quotients associated with the Federal Safe Drinking Water Act MCLs were calculated using the risk assessment methodology presented in the OU A RICS and OU A RICS Addendum (Jacobs, 2001 and 2002), and are shown in Table 2. The VOCs listed in Table 2 are the COCs in groundwater and were reported at concentrations greater than MCLs during 2005 and 2006. The risk calculations were based on the assumption that potential exposures to VOCs in groundwater could occur through the following exposure pathways: (1) ingestion of drinking water, (2) inhalation of VOCs that have volatilized from water, and (3) dermal contact with water while showering or bathing.

The cumulative risk associated with VOCs in groundwater will vary with the number of VOCs and concentrations present in a particular portion of the groundwater plume. TCE is the most widespread VOC in groundwater and is found at the highest concentrations of any of the VOCs. Historically, TCE concentrations have exceeded 10,000 micrograms per liter (µg/L) but have been reduced with the implementation of the groundwater extraction and treatment system and the SVE systems. Currently, concentrations of TCE in groundwater are as high as 6,700 µg/L. At this concentration, the hypothetical excess carcinogenic risk (i.e., assuming human exposure) is approximately five in one thousand and the non-carcinogenic hazard quotient is greater than 1 under the residential scenario. The risk exceeds the NCP acceptable risk range of one in a million (E-06 or 10^{-6}) to one in ten thousand (E-04 or 10^{-4}) excess lifetime cancer risks, and acceptable non-cancer hazard quotient of 1.

Chloroform is an exception to the otherwise general rule that the excess lifetime cancer risks associated with MCL concentrations in groundwater fall within the acceptable NCP risk range of 10^{-6} to 10^{-4}.

Although the risk associated with chloroform at its MCL exceeds the NCP risk range, chloroform is not expected to drive the cleanup process. Chloroform is reported at a concentration exceeding its MCL at only one well, MW-334 located in OU A. Other VOCs were found to be significantly above their MCLs in samples from this well. Because the

extraction and treatment system is effective for all of the VOCs, the chloroform concentrations will be reduced over time. Chloroform is not likely to be the last VOC to reach its MCL and can be expected to be well below its MCL when other VOCs are remediated to, or below, their respective MCLs.

The risk to human health from exposure to VOC-contaminated groundwater is only one component of risk at a given site. Other components include other potential contaminants in groundwater and soil (for example, non-VOCs, VOCs, radiological, or petroleum constituents). As discussed in Sections 2.4 and 2.5, risks from exposure to non-VOC contaminated groundwater are currently being addressed in the non-VOC RI. A ROD for non-VOC contaminants in groundwater is planned for 2008. Additionally, risks to human health from exposure to VOC and non-VOC contaminants in soil (including inhalation of VOCs in indoor air) are being addressed through parcel-specific FSs and subsequent RODs.

2.7.2 Ecological Risks

An ecological scoping assessment was performed in 1995 at McClellan (Jacobs, 1995). That assessment identified two Installation Restoration Program sites and four habitats as having potential ecological concerns. Impacts from VOCs have not been observed at these locations. No significant pathways to ecological receptors for VOC-contaminated soil are expected at the Base. Therefore, it has been determined that no significant risk to ecological receptors from VOCs is present at the Base.

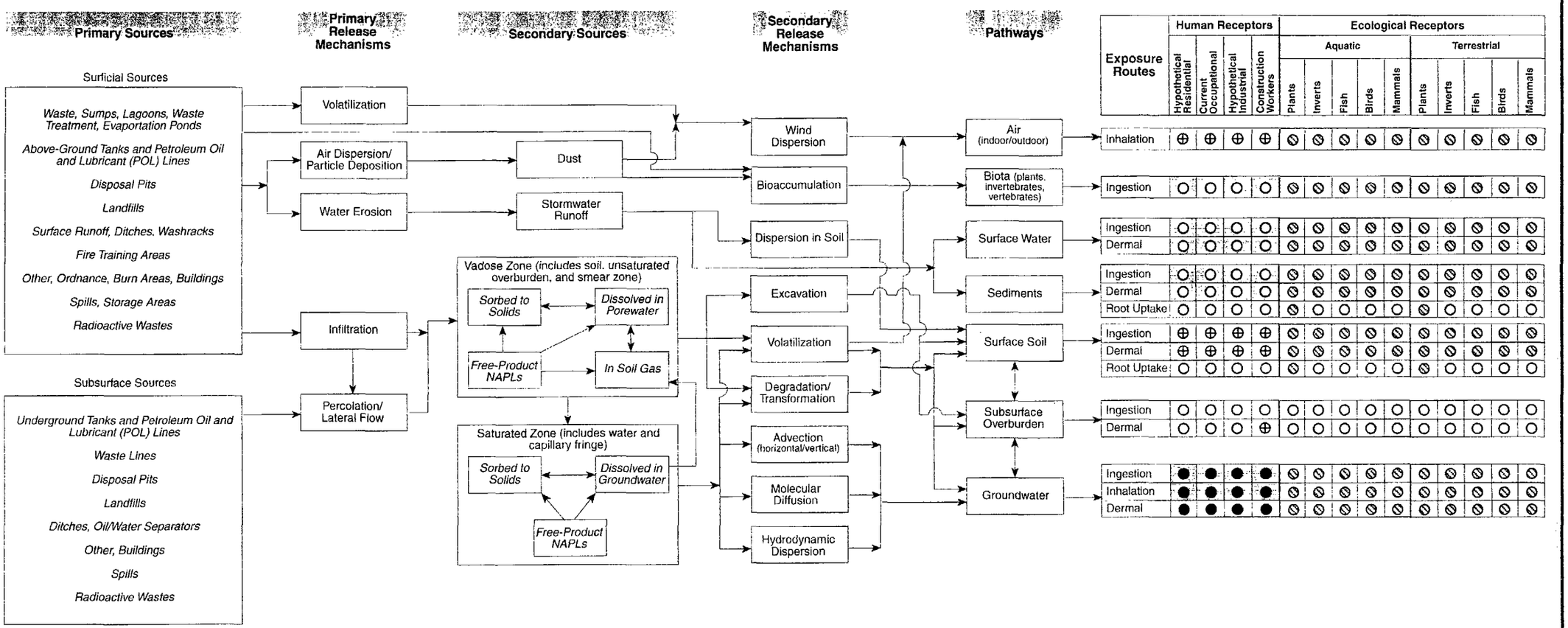
2.7.3 Basis for Taking Response Action

The Air Force, as the lead agency, believes that the response action selected in this ROD meets the requirements for protecting human health and the environment from actual or threatened releases of hazardous substances from this site.

2.8 Remedial Action Objectives

McClellan has developed remedial action objectives (RAOs) to describe how the remedy is expected to address site risks. These RAOs are based on future land uses, and address exposure risks by removing contamination and isolating potential receptors from contamination. Following are the RAOs:

- Control and clean up groundwater with VOC concentrations in excess of the MCLs to prevent their migration.
- If cost effective and reasonably feasible, clean up concentrations below MCLs to restore water to drinking water conditions.
- Protect public health and the environment from exposure to VOCs in groundwater by ensuring that groundwater in the McClellan plumes is not used for human consumption.
- Remove VOCs from the vadose zone that threaten to migrate to groundwater, so long as it is more cost effective to remove the VOCs than allow the VOCs to move to groundwater.
- Protect remedial and groundwater monitoring systems from damage.



NOTES

- ● Potentially complete pathways applicable to VOCs and considered in this ROD.
- ⊕ Potentially complete pathways applicable to VOCs. These will be evaluated in parcel-specific soil RODs.
- ⊘ Potentially complete pathway, but not significant for VOCs and, therefore, not evaluated in this ROD.
- ○ Incomplete pathway for this scenario.

1.) Shaded boxes indicate human risk assessment exposure routes evaluated in Basewide RI (Radian, 1997); unshaded boxes are human and ecological risk exposure pathways not shown in the Basewide RI.

FIGURE 10
EXPOSURE PATHWAY ANALYSIS
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

TABLE 1
Sites with VOC Detections that could Impact Groundwater
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

WIMS ID[a]	Site ID[b]	Site Description
SD007	CS 007	Sludge/oil pit
LF008	PRL 008	Sludge refuse/landfill
LF009	PRL 009	Possible landfill
LF010	CS 010	Landfill
LF011	CS 011	Landfill
LF012	CS 012	Landfill
LF013	CS 013	Landfill
LF014	CS 014	Landfill
DP015	PRL 015	Sodium valve trench
DP016	PRL 016	Sodium valve trench
LF018	PRL 018	Landfill
DP020	PRL 020	Sludge/Oil Pit
DP021	PRL 021	Sludge/Oil Pit
LF022	CS 022	Burn pit/landfill
LF023	CS 023B	Landfill
LF024	CS 024	Landfill
LF025	PRL 025	Landfill
DP028	PRL 028	Skimming basin
SS029	PRL 029	Landfill
DP030	CS 030	Surface spill area
SS031	CS 031	Incinerator ash burial pit
WP033	PRL 033	IWTP sludge landfarm
ST034	CS 034	Waste sol. storage tanks
SS036	CS 036	Open storage area
LF037	CS 037	Landfill
LF038	CS 038	Engine repair shop
LF039	PRL 039	Landfill
WP040	CS 040	Industrial wastewater sludge
LF041	PRL 041	Landfill
LF042	CS 042	Oil storage/landfill
LF043	CS 043	Burnpit
SS045	CS 047	Abandoned plating shop
WP046	CS 048	Abandoned IWTP
LF047	PRL 049	Possible landfill

TABLE 1
Sites with VOC Detections that could Impact Groundwater
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

WIMS ID[a]	Site ID[b]	Site Description
DP050	CS 052	Fill area
WP051	PRL 053	Settling pond
SS053	PRL 055	Acid storage area/landfill
WP056	PRL 060	Holding ponds
WP057	PRL 061	Chemical waste pit
WP058	PRL 062	Chemical waste pit
SD059	PRL 063	Unlined ditch
LF061	PRL 065	Landfill
WP062	PRL 066	Ditches and pond
WP063	CS 067	Landfill
WP064	PRL 068	Sludge ponds
DP065	CS 069	Burn pit
WP068	GWTP	Groundwater treatment plant
LF069	PRL B-001	Landfill
LF071	PRL B-003	Landfill
LF073	CS B-005	Empty lot
LF075	PRL B-007	Former spoil area
LF076	PRL B-009	Landfill
SD077	PRL P-001	Drainage ditch, former engine test pad
SD078	PRL P-002	Waste pond
WP079	PRL P-003	Oil pit
WP080	PRL P-004	Sump
SD081	CS P-005	Open ditch
SD082	CS P-006	Open ditch
SD083	PRL P-007A	Unlined drainage ditch
SD085	PRL P-009	Open drainage ditch
SS086	PRL S-001	Plating shop
SS087	PRL S-002	Chemical warehouse
SS088	PRL S-003	Acid storage Warehouse
SS089	PRL S-004	Treat. plant/sludge beds
WP090	PRL S-005	Abandoned IWTP
WP091	PRL S-006	IWTP #1
WP092	CS S-007	IWTP #3
SS093	PRL S-008	Electroplating shop, IWTP

TABLE 1
Sites with VOC Detections that could Impact Groundwater
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

WIMS ID[a]	Site ID[b]	Site Description
SS094	PRL S-009	Asbestos storage
SS096	PRL S-011	BCE/PCE storage
SS097	PRL S-012	PCB storage
SS098	PRL S-013	Open storage
SD099	PRL S-014	Paint shop/spray booths
SD100	PRL S-015	Aircraft repair, electrical/machine shops, foundry
SD101	PRL S-016	Sol./paint spray booths
SD102	PRL S-017	Repair shop/spray booths
SD103	PRL S-018	Repair shop/clean shop
SS104	PRL S-019	Entomology storage area
SD105	PRL S-020	Photo lab
SD106	CS S-021	Degreaser/spray booths
SD107	PRL S-022	Repair shop/spray booths
SD108	PRL S-023	Plating shop
SD109	CS S-024	Depaint washrack
SD110	PRL S-025	Transformer shop
SD111	CS S-026	Mainshop/spray booth
SD112	CS S-027	Solvent recovery stills
SS113	PRL S-028	Oil/paint storage
SS114	PRL S-029	Equipment repair
SD115	PRL S-030	Depaint washrack
SD116	PRL S-031	Aircraft paint hanger
SS117	PRL S-032	Paint storage area
SS118	PRL S-033	Hazardous material storage
SD119	PRL S-034	Degreaser/paint booth
SD120	PRL S-035	Solvent spray booth
SS121	PRL S-036	Oil drum storage
SS122	PRL S-037	Oil drum storage
SS123	PRL S-038	Drum storage
SS124	PRL S-039	Former aircraft maintenance area (current museum site)
SD125	PRL S-040	Aircraft maintenance/engine testing area
SD126	PRL S-041	MAT K storage
SD128	PRL S-043	Aircraft washrack
SD129	PRL S-044	Aircraft maintenance area

TABLE 1
Sites with VOC Detections that could Impact Groundwater
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

WIMS ID[a]	Site ID[b]	Site Description
SD130	PRL S-045	Aircraft maintenance area
ST131	PRL T-006	Underground storage tank (UST)
ST132	PRL T-007	Sol pit/waste thinner tank
ST133	PRL T-008	Fuel tank
ST134	PRL T-010	Solvent tank
ST137	PRL T-015	Tank Farm 1
ST138	CS T-016	Tank Farm 2
ST139	CS T-017	Tank Farm 3W
ST140	PRL T-018	Tank Farm 4
ST141	PRL T-019	Tank Farm 5
ST142	CS T-020	Tank Farm 6
ST144	CS T-030	UST
ST146	PRL T-032	UST, aircraft maintenance
ST147	PRL T-033	UST, aircraft maintenance
ST148	CS T-036	UST
ST149	CS T-037	UST
ST150	PRL T-044	Firehouse, engine repair facility
SD155	PRL T-046	Defueling Tanks
SD156	CS T-047	Oil/water separator
SD157	PRL T-048	Oil/water separator UST
WL158	PRL L-001	Industrial wastewater line (IWL)
WL159	PRL L-002	IWL
WL160	PRL L-003	IWL
WL161	PRL L-004	IWL
WL162	PRL L-005	IWL
WL163	PRL L-006	IWL
WL164	PRL L-007	IWL
SD165	Magpie Creek (formerly PRL P-010, now AOC 322)	Magpie Creek
SS168	PRL S-048	Jet engine test pad
WL169	CS T-057	IWL drain at Building. 431
ST171	PRL T-060	UST
DP178	VZ	Vadose zone
WP179	SA 001	Surface disposal

TABLE 1
Sites with VOC Detections that could Impact Groundwater
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

WIMS ID[a]	Site ID[b]	Site Description
SS180	SA 002	Laboratory
SD181	SA 003	Washrack
SS182	SA 004B	Paint shop
SS183	SA 005	Paint storage/boiler
SS184	SA 006	Gas station
SD185	SA 007	Washrack
ST186	SA 008	UST
SS187	SA 009	Hazardous mat. storage
SS188	SA 010	Entomology sumps
ST189	SA 011	UST
SS190	SA 012	Transformer oil area waste pit
SS191	SA 013	Chemical storage area
SD192	SA 014	Storm water drainage
SS193	SA 015B	NW corner lot 10 spill
SD194	SA 016	Hangars/storage area
SS196	SA 018	Oil storage yard
SD197	SA 019	Spray booth
ST198	SA 035	UST
SS199	SA 037	Motor pool
ST200	SA 038	UST
SS201	SA 040	Chemical storage area
SS202	SA 041	Metal fabrication
WP204	SA 044	Sump
SS205	SA 045	Soil contamination
ST206	SA 046	UST
SD207	SA 047	Washrack 254
ST208	SA 048	Warehouse
ST209	SA 049	UST
ST210	SA 052	Blowdown tanks
WP211	SA 053	Washrack
ST212	SA 054	Aboveground storage tank (AST)
SS213	SA 055	Laboratory
SD214	SA 056	Wastewater
SS215	SA 058	Chemical storage tank

TABLE 1
Sites with VOC Detections that could Impact Groundwater
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

WIMS ID[a]	Site ID[b]	Site Description
ST216	SA 059	UST
WP217	SA 060	Industrial wastewater drain
SD218	SA 061	Solvent spray booth
WL220	SA 065	IWL
SS221	SA 066	Motor pool
SS222	SA 067	Soil contamination
SS223	SA 068	Aircraft maintenance
WP224	SA 069	Steam Fac./UST
WL225	SA 070	IWL
SS226	SA 071	Hazardous material storage
ST228	SA 074	AST, UST
WL229	SA 075	IWL
SS230	SA 076	Hazardous material storage
ST231	SA 077	AST
ST233	SA 079	Fuel Test Fac.
SS234	SA 080	Contractor staging
ST235	SA 081	Fuel lines
SD236	SA 084	Spray booth
WP238	SA 086	Engine test/UST
ST239	SA 087	UST
SS240	SA 088	Soil contamination
SS241	SA 089	Open storage area
SS242	SA 090	Washrack
SS243	SA 091	Soil contamination
ST245	SA 094	Open storage area
ST246	SA 095	UST
WP247	SA 096	UST
SD248	SA 097	Tank farm
SS249	SA 098	Spray booths
ST251	SA 100	Doc. Destruct./UST
WP252	SA 101	Sump
SS254	SA 105	Laboratory
ST255	SA 106	Salvage yard/UST
SS256	SA 107	Engine test stands

TABLE 1
Sites with VOC Detections that could Impact Groundwater
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

WIMS ID[a]	Site ID[b]	Site Description
SD258	SA 109	Magpie Creek contamination
LF262	AOC F-4	Burial pit area
SI263	AOC F-5	Waste disposal area
LF265	AOC G-1	Landfill area and firing range
PL266	AOC G-2	Pol storage area
MY267	AOC G-3	Aircraft maintenance apron
MY268	AOC G-4	Aircraft maintenance metals/wood/auto shops
MY269	AOC G-5	Aircraft maintenance hangar
PL270	AOC H-1	Building 900 gas station
SS271	AOC H-10	Former aircraft apron
SD273	AOC H-12	Weather squadron, shop, rad, or depot
SS274	AOC H-13	Auto hobby shop
SI275	AOC H-14	Dry impoundment area
SS278	AOC H-4	Revetments
SS283	AOC H-9	Stains on taxiway, battery pit
SP284	BLDG 600	Building 600
SS285	BLDG 635	AeroClub
MY287	CS S-049	Maintenance
TA289	Free Oil Tank	Free oil separation tank for IWTP
TU291	SA 029	Calibration shop/UST
SS292	SA 034	Industrial electronics control
SS295	SA 063	Electronics maintenance
RW297	SA 102	Paint booth/washrack
SS298	SA 104	Maintenance/soil spray booth
SS300	SSA 002	Special study area
TU303	Tank 701	Former diesel UST – removed
TU305	Tank 714	Chemical and/or waste oil USTs
TU306	Tank 737	Tank 737
DP310	Wastepile	Waste pile
TU312	Gas Station	Gas station
AT313	Fire Train	Fire training area
SD316	Drainage OU C	Drainage ditch

[a] WIMS ID = Site identification code in the Air Force Work Information Management System
[b] Site ID = More commonly used site identifier than WIMS ID at McClellan

TABLE 2
Cleanup Levels (MCLs) for COCs in Groundwater and Estimated Human Health Risks
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Contaminants of Concern	Maximum Reported Concentration (µg/L)[a]	Maximum Contaminant Level (µg/L)[b]	Excess Lifetime Cancer Risk at MCL				Noncancer Hazard Quotient (HQ) at MCL			
			Water Ingestion	Dermal Contact	Inhalation (emissions from water)	Total Risk	Water Ingestion	Dermal Contact	Inhalation (emissions from water)	Total Hazard Quotient
1,2-Dibromoethane	0.53	0.05	2.7E-06	1.4E-07	7.4E-06	**1E-05**	0.00036	0.000014	0.07	**0.07**
1,1-Dichloroethane	57	5	4.2E-07	2.4E-08	2.1E-06	**3E-06**	0.0032	0.00014	0.011	**0.02**
1,1-Dichloroethene	310	6	N/A	N/A	N/A	**N/A**	0.0077	0.00059	0.096	**0.1**
1,2-Dichloroethane	640	0.5	6.8E-07	2.4E-08	3.4E-06	**4E-06**	0.0016	0.000044	0.11	**0.1**
1,1,2-Trichloroethane	5.3	5	5.4E-06	4.8E-07	2.1E-05	**3E-05**	0.08	0.0056	0.4	**0.5**
Benzene	29	1	1.5E-06	2.2E-07	7.4E-06	**9E-06**	0.016	0.0019	0.037	**0.05**
Carbon tetrachloride	89	0.5	1.1E-06	3.0E-07	5.6E-06	**7E-06**	0.046	0.0097	0.23	**0.3**
Chloroform[c]	440	80	3.7E-05	2.4E-06	4.8E-04	**5E-04**	0.51	0.026	1.8	**2**
cis-1,2-Dichloroethene	340	6	N/A	N/A	N/A	**N/A**	0.038	0.0025	0.19	**0.2**
Methylene chloride	3.3	5	1.0E-06	3.6E-08	1.3E-06	**2E-06**	0.0053	0.00014	0.014	**0.02**
PCE	580	5	4.0E-05	2.6E-05	7.8E-06	**7E-05**	0.032	0.016	0.16	**0.2**
TCE	6,700	5	9.7E-07	1.2E-07	2.6E-06	**4E-06**	1.1	0.10	0.0094	**1**
Vinyl chloride	22	0.50	1.1E-05	5.3E-07	1.0E-05	**2E-05**	0.011	0.00039	0.0056	**0.02**

Notes:

[a] Maximum reported concentration from the fourth quarter of 2005 through the third quarter of 2006.
[b] MCLs presented in this table are the lowest of either the State or Federal MCL.
[c] When TCE reaches its MCL, chloroform concentrations are expected to be below the MCL for chloroform and the risk will be in the risk range of 10^{-6} to 10^{-4} and the hazard quotient will be less than one.

Estimated lifetime cancer risks and non-cancer hazard quotients were calculated using the assumptions presented in the Final OU A RICS (Jacobs, 2001). These risk estimates were calculated assuming residential use of groundwater and potential exposure through ingestion of water, dermal contact with water while showering or bathing, and inhalation of VOCs volatilized from water. Cancer risks were based on adult exposure parameters and the noncancer hazards were based on child exposure parameters.

N/A = Not applicable. Cancer slope factors are not available for this chemical.

2.9 Description of Alternatives

In the VOC FS (CH2M HILL, 1999), nine remedial alternatives (Alternatives 1 through 9) were developed to address VOC contamination in groundwater and the vadose zone. Two of these alternatives (Alternatives 8 and 9) were not retained for evaluation based on the preliminary screening. Three additional alternatives (2B, 3A, and 3B) were developed for the VOC FS as part of the sensitivity analysis. Alternatives 2B and 3B include aggressive groundwater cleanup to the MCL and water quality objective (WQO) cleanup levels, respectively. Alternative 3A was recommended for evaluation by the RWQCB and includes a combination of the two cleanup levels (therefore, there is no corresponding Alternative 2A). Alternative 7 includes less aggressive containment of groundwater contamination and fewer SVE systems.

A summary of the 10 alternatives is provided in Table 3. The alternatives are discussed in detail in Section 4.2 of the VOC FS (CH2M HILL, 1999). In addition, an Addendum to the VOC FS was prepared in 2004 (AFRPA, 2004c) to more fully describe and evaluate the institutional controls that are part of each of the alternatives except for Alternative 1 – No Action. Institutional controls are a component of each of the alternatives, except for Alternative 1. Institutional controls are non-engineering, non-technical mechanisms used to reduce or prevent human exposure to contaminants. The institutional controls include enforceable use restrictions and a SLUC, and are described in detail in Section 2.11.3 of this ROD.

TABLE 3
Summary of Remedial Alternatives
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Alternative		Description
1	No Action with Limited Groundwater Monitoring	Current remedial activities would be terminated, and no further remedial activities would be implemented. Limited monitoring of groundwater would be performed annually, and land use restrictions would be implemented. Institutional controls would be implemented to prevent or reduce exposure to hazardous substances and to aid in the implementation of the alternative.
2	Prioritized Implementation of SVE/Cleanup of the MCL Plumes/ Monitoring for VOCs/Institutional Controls	Institutional controls, groundwater extraction, treatment, and monitoring, and prioritized SVE would be implemented. The objective would be to clean up VOCs within the MCL groundwater plumes and remove VOCs in vadose zone source areas. Alternative 2 includes up to 85 extraction wells and 18 SVE systems.
2B	Prioritized SVE/Aggressive Cleanup of MCL Plumes/ Monitoring for VOCs/Institutional Controls (Selected Remedy)	Alternative 2B is the same as Alternative 2 except for the number of groundwater extraction wells. Under Alternative 2B, there would be up to 106 extraction wells providing a more aggressive extraction of contaminated groundwater.
3	Prioritized Implementation of SVE/Cleanup of the WQO Plumes/Monitoring for VOCs/Institutional Controls	This alternative is the same as Alternative 2 except that the target volume for groundwater is based on the WQOs rather than MCLs. Institutional controls, groundwater extraction, treatment, and monitoring and prioritized SVE would be implemented. The objective of Alternative 3 would be to clean up VOCs within the WQO groundwater plumes and remove VOCs in vadose zone source areas. Alternative 3 would have up to 99 extraction wells and 18 SVE systems.

TABLE 3
Summary of Remedial Alternatives
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Alternative		Description
3A	Prioritized SVE/Aggressive WQO Cleanup of Plumes Until Last Extraction Well Meets MCLs/ Monitoring for VOCs/Institutional Controls	Alternative 3A was developed from Alternative 3B and recommended for evaluation by the RWQCB. Alternative 3A would install exactly the same components as Alternative 3B; however, the cleanup standard for groundwater would be implemented differently. Under Alternative 3A, groundwater extraction wells would continue to operate until the WQO standard was reached. However, at the end of the cleanup, when the last well reaches the MCLs, the cleanup standard converts from WQOs to MCLs. At that point, any operating wells – even if they have not attained the WQOs – would be shut down, and the groundwater cleanup would be complete.
3B	Prioritized SVE/Aggressive WQO Cleanup of Plumes/Monitoring for VOCs/Institutional Controls	Alternative 3B is the same as Alternative 3 except for the number of groundwater extraction wells. Under Alternative 3B, up to 120 groundwater extraction wells would be operated to provide a more aggressive cleanup.
4	Prioritized Implementation of SVE/Cleanup and Monitored Natural Attenuation (MNA) of the MCL Plumes/Monitoring for VOCs/Institutional Controls	MNA is used to remediate some portions of the MCL plumes. Under Alternative 4, institutional controls, groundwater extraction, treatment, and monitoring, and prioritized SVE would be implemented. The objective of Alternative 4 would be to clean up VOCs within portions of the MCL groundwater plumes, treat low VOC concentration areas in the remainder of the MCL plumes with in situ MNA, and remove VOCs in vadose zone source areas. In addition to MNA, Alternative 4 would require up to 75 extraction wells and 18 SVE systems.
5	Prioritized Implementation of SVE/Cleanup and MNA of the WQO Plumes/Monitoring for VOCs/Institutional Controls	Alternative 5 is the same as Alternative 4 except that the target volume for groundwater was based on WQOs rather than MCLs. Alternative 5 would include institutional controls, groundwater extraction, treatment, monitoring, MNA, and additional SVE. The objective of Alternative 5 would be to clean up VOCs within the WQO groundwater plumes, treat low VOC concentration areas in the remainder of the WQO plumes with in situ MNA, and remove VOCs in vadose zone source areas. In addition to MNA, Alternative 5 would require up to 78 extraction wells and 18 SVE systems.
6	Prioritized Implementation of SVE/ Less Aggressive Cleanup of Hot Spots/Cleanup and MNA of the MCL Plumes/Monitoring for VOCs/Institutional Controls	Alternative 6 is similar to Alternative 4 in all elements except that the hot spots would not be pumped as aggressively. The objective of Alternative 6 would be to less-aggressively clean up VOCs within the groundwater hot spots, clean up VOCs in portions of the MCL groundwater plumes that are outside of the hot spots, address low VOC concentration areas in the remainder of the MCL plumes with in situ MNA, and remove VOCs in vadose zone source areas. In addition to MNA, Alternative 6 would require up to 65 extraction wells and 18 SVE systems.
7	No Additional SVE/Containment of the MCL Plumes/Monitoring for VOCs/Institutional Controls	This alternative is similar to the interim remedy for groundwater established in the GWOU IROD (McClellan AFB, 1995). The objective of Alternative 7 would be to contain the entire MCL plumes and remove VOCs in vadose zone source where SVE Removal Actions have already been initiated. Alternative 7 would require up to 75 extraction wells and 6 SVE systems.

Notes:

A more detailed description of the basic alternatives, especially institutional controls, can be found in the Final Addendum to the 1999 McClellan AFB Basewide VOC FS (AFRPA, 2004c).

WQOs are listed in Table 2-4 of the Final Basewide VOC Feasibility Study Report (CH2M HILL, 1999).

The values selected for the WQOs for carcinogenic VOCs were concentrations corresponding to a one in a million (E-06 or 1×10^{-6}) incremental excess lifetime risk for ingestion of drinking water, calculated using cancer potency factors developed by Cal-EPA. The values selected for the WQOs for non-carcinogenic VOCs were concentrations corresponding to EPA Integrated Risk Information System (IRIS) Reference Doses (RfDs) expressed as drinking water levels.

2.10 Comparative Analysis of Alternatives

Section 6.0 of the VOC FS (CH2M HILL, 1999) provides a comparative evaluation of the alternatives. In addition, a detailed analysis of the institutional controls is provided in Section 6.2 of the VOC FS Addendum (AFRPA, 2004c). The comparative analysis of alternatives is summarized in Table 4.

All of the alternatives except Alternative 1, the No Action alternative, provide adequate protection of human health and the environment. Similarly, the Air Force believes that all alternatives except Alternative 1 could be implemented to meet all applicable or relevant and appropriate requirements (ARAR). Because Alternative 1 does not satisfy these two threshold criteria, it is ruled out for further consideration. Some alternatives would provide greater protection of human health and the environment than others. Alternatives 2, 2B, 3, 3A, and 3B, would be more protective because they would be the most aggressive in addressing the VOC plumes.

Alternatives 2 through 7 and their variants all achieve some measure of long-term effectiveness and permanence, although all would achieve their stated objectives only after decades of active extraction and treatment. Alternatives 3, 3A, and 3B leave behind the least amount of residual VOCs, because they clean to WQOs, and thus have the highest degree of long-term effectiveness. Alternatives 2 and 2B leave behind very low levels of residual VOCs and achieve a high degree of long-term effectiveness.

Groundwater extraction and treatment and SVE operations reduce the mobility, toxicity, and volume of VOCs through capture and treatment to slightly varying degrees depending on the cleanup standard. Alternatives 2, 2B, 3, 3A, 3B, and 7 are equal in meeting the preference for treatment, and the treatment process is irreversible.

All alternatives have a high degree of implementability.

The VOC FS evaluated the costs for each alternative assuming that the water table continued to decline. These total costs (including capital and O&M costs for SVE and Groundwater Extraction and Treatment) are shown in Table 4 in 1997 dollars. With the exception of the No Action alternative and Alternative 7, Alternative 2B had the lowest total cost. The increased capital costs for installation of more groundwater wells under Alternative 2B (that had not yet been installed as of the VOC FS) were compensated for by decreased O&M costs because the duration of Alternative 2B was less than for the other alternatives. In a sensitivity study, the VOC FS also evaluated costs if the water table stabilized at approximately 100 feet below ground surface (bgs) as has occurred. The predicted costs were much higher under this scenario because SVE could not be used to quickly and efficiently remove VOCs from portions of the aquifer that are saturated. Recently, Alternative 2B cost estimates have been revised substantially lower to reflect the current conceptual site model (stabilized water table elevation at approximately 100 feet bgs) using the output from the new fate and transport model. See Section 2.11.4 for additional information.

2.11 Selected Remedy

The Selected Remedy for addressing VOC contamination at McClellan is Alternative 2B, Groundwater Extraction and Treatment combined with SVE and institutional controls. Under this alternative, the Air Force plans to aggressively contain and clean up the groundwater plumes to MCLs. Each element of the Selected Remedy is described in detail in the sections that follow.

2.11.1 Groundwater Extraction and Treatment

Under Alternative 2B, new extraction wells were to be installed as defined in the VOC FS (CH2M HILL, 1999). Phase III of the IROD was designed so that, with its implementation, the extraction and treatment capability at McClellan defined by Alternative 2B is complete. Consequently, 41 extraction wells were installed as part of Phase III of the interim remedy for the 1995 Basewide GWOU IROD that was completed in September 2005.

Groundwater extraction wells are placed in areas where VOCs are in groundwater, particularly areas that will take the longest time to clean up. Extracted groundwater is conveyed to a treatment system and the VOCs are removed. The locations of the groundwater extraction and conveyance components are shown on Figure 2. Groundwater treatment will continue to be provided at the existing groundwater treatment plant (GWTP). Modifications to the GWTP have already been implemented to increase the treatment plant capacity. Current treatment system components include air stripping followed by treatment with granular activated carbon. Treatment methods may change as conditions change or new and improved technologies become available.

Currently, the influent to the GWTP is somewhat less than 2,000 gallons per minute. Over time, the flow rate to the GWTP will decrease as the groundwater is remediated and the groundwater VOC plumes shrink. Treated groundwater will continue to be discharged to Magpie Creek and Beaver Pond, which drains into adjacent Don Julio Creek. The substantive requirements for discharge of the treated groundwater to surface water are shown in Table 5 and provided in Appendix G of the GWTP O&M Manual (URS, 2006b).

Groundwater monitoring will be performed to provide the information necessary to evaluate the effectiveness of the groundwater extraction system. The number of samples collected and groundwater elevations measured will be adjusted as the VOC groundwater plumes shrink and as VOC concentration trends are established. Extraction and monitoring wells may be eliminated or added as needed to optimize the groundwater cleanup and monitoring program. The current groundwater monitoring program is described in the Groundwater Monitoring Plan Update (URS, 2006c).

The selected remedy and proposed cleanup levels include all portions of the VOC groundwater contaminant plumes above the cleanup levels, regardless of whether they are located within or outside the former base boundaries.

TABLE 4
Comparative Analysis of Alternatives
Basewide VOC Groundwater ROD, Former McClellan Air Force B

Alternative	Description of Alternativ	plementability	Total Cost ($ millions) (1997 $$)[a,b]	Annual O&M Costs ($ millions)[a,b]
1	No Action, cleanup systems currently in operat down.	YES	Indefinite[c]	0.16
2	Groundwater cleanup to Drinking Water Stand 85 extraction wells and up to 18 SVE systems.	YES	165	4.4
2B[d]	Groundwater cleanup to Drinking Water Stand 106 groundwater extraction wells and up to 18	YES	152[a]	4.5[a]
3	Groundwater cleanup to State WQOs, which a level than Drinking Water Standards, with up t and up to 18 SVE systems.	YES	254	4.5
3A	Groundwater cleanup to State WQOs, with up wells and up to 18 SVE systems. Once all con reach Drinking Water Standards, the cleanup complete, even if some plumes remain above	YES	166	4.6
3B	Groundwater cleanup to State WQOs, with up extraction wells and up to 18 SVE systems.	YES	175	7.6
4	Groundwater cleanup to Drinking Water Stand 75 extraction wells, and reliance on the natura VOCs in portions of the contamination plumes treated. Up to 18 SVE systems.	YES	171	4.4
5	Groundwater cleanup to Drinking Water Stand 78 extraction wells, and reliance on the natura VOCs in portions of the contamination plumes treated. Up to 18 SVE systems.	YES	233	4.5
6	Groundwater cleanup to Drinking Water Stand 65 extraction wells, and reliance on the natura VOCs in portions of the contamination plumes treated. Up to 18 SVE systems.	YES	162	4.4
7	Groundwater containment until Drinking Water attained, with up to 75 extraction wells and 6 S	YES	119	2.9

[a] Total costs as shown in the VOC FS (CH2M HILL, 1999). Ba ss than estimated in the VOC FS. However, the comparisons between alternatives using the VOC FS estima
[b] Institutional controls are factored into the Total and Annual C
[c] A total cost is not presented for Alternative 1 because the an
[d] Selected Remedy.

Note:

Alternatives 2 through 7 use SVE and groundwater extraction a cleanup the groundwater more aggressively.

TABLE 5
Substantive Requirements for the GWTP Discharge of Treated Groundwater to Surface Water
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Effluent from Outfall 001 (Magpie Creek) or Outfall 002 (Beaver Pond & Don Julio Creek) shall not exceed the following limits:

Constituents	Units	Daily Maximum	Monthly Average	Monthly Median
Volatile Organic Compound COCs[a]	µg/L (ppb)	1.0[c]	—	[d]
	lbs/day	0.024[f]	—	—
	lbs/day	0.0012[g]	—	—
Pesticides[b]	µg/L (ppb)	[e]	—	—
Hexavalent Chromium	µg/L (ppb)	14.1	10	—
	lbs/day	0.24[f]	0.24[f]	—
	lbs/day	0.017[g]	0.012[g]	—
	µg/L (ppb)	19.5	16.5	—
	lbs/day	0.47[f]	0.40[f]	—
	lbs/day	0.023[g]	0.8[g]	—
Selenium (Total)	µg/L (ppb)	8.2	4.1	—
	lbs/day	0.20[f]	0.10[f]	—
	lbs/day	0.01[g]	0.005[g]	—
	µg/L (ppb)	10	—	—
	lbs/day	0.24[f]	—	—
	lbs/day	0.012[g]	—	—
Mercury	µg/L (ppb)	—	0.012	—

[a] The VOC COCs are: 1,1-DCA, 1,2-DCA, 1,1-DCE, cis-1,2-DCE, PCE, 1,1,1-TCA, 1,2-Dibromoethane, TCE, vinyl chloride, methylene chloride, chloroform, carbon tetrachloride, and benzene.
[b] Those pesticides identified in Table 2d of Appendix 4 to the State Implementation Plan (SIP) (State Water Resources Control Board [SWRCB], 2005).
[c] Using EPA Test Method with MLs equal to or less than MLs specified by the SIP, Appendix 4, Table 2a, or later amendment.
[d] Less than MLs identified in Table 2a of Appendix 4 to the SIP or Section 8 of the Basewide Quality Assurance Project Plan (QAPP) (URS, 2003). For compliance determination purposes, use an EPA Test Method with MLs equal to or less than MLs specified by the SIP, Appendix 4, Table 2a, or later amendment.
[e] Less than MLs for those pesticides identified in Table 2d of Appendix 4 to the SIP or Section 8 of the Basewide QAPP. For compliance determination purposes, use an EPA Test Method with MLs equal to or less than MLs specified by the SIP, Appendix 4, Table 2d, or later amendment.
[f] Limit for Outfall 001, based upon maximum daily discharge limit of 2.88 mgd.
[g] Limit for Outfall 002, based upon maximum daily discharge limit of 0.144 mgd.

COC = contaminant of concern
DCA = dichloroethane
DCE = dichloroethene
EPA = United States Environmental Protection Agency
lb = pound
mgd = million gallons per day
ML = minimum level
PCE = tetrachloroethene
ppb = parts per billion
QAPP = quality assurance project plan
SIP = State Implementation Plan
TCA = trichloroethane
TCE = trichloroethene
µg/L = micrograms per liter

There have been two disputes between the Air Force and the regulatory agencies related to selection of the remedy for VOCs in groundwater at McClellan. The resolutions to both of the disputes have been incorporated into this remedy. The 2001 dispute resolution identified MCLs as the cleanup standard for VOCs in groundwater with continued groundwater extraction and treatment until MCLs are achieved. As determined in the Resolution of Formal Dispute of the Proposed Plan for the VOC Operable Unit, dated 5 December 2001 (included as Attachment 1A of this ROD), when TCE achieves its MCL of 5 ppb in each plume as defined by the BRAC cleanup team, the Air Force, in collaboration with the State of California and EPA Remedial Project Managers, will complete an analysis and report within 60 days (using agreed upon models) evaluating the technical and economic feasibility of continuing groundwater extraction and treatment until plume levels reach 2.3 ppb TCE. After the Air Force submits this report, the parties will have another 30 days to reach an agreement. If an agreement cannot be reached, the Air Force may shut off the extraction wells and any party may use the dispute resolution provisions of the Federal Facilities Agreement.

As part of the 2005 dispute resolution (Resolution of the McClellan AFB VOC Groundwater ROD Dispute, dated 8 September 2005 and included as Attachment 1B of this document), the Air Force agreed that the drinking water beneath McClellan AFB is a designated drinking water aquifer and that MCLs are the relevant and appropriate cleanup standards for the groundwater cleanup at McClellan. In addition, all parties acknowledged that the 2001 dispute resolution agreement (Attachment 1A) is still applicable to any final groundwater cleanup decisions.

Subsequent to both disputes, the JTT Remedy Consensus for the McClellan AFB VOC ROD Dispute Letter (dated 25 July 2006 and included as Attachment 1C of this document) stated the following JTT recommendations: (1) IROD remedial action is the proposed VOC ROD remedy, (2) MCLs are the relevant and appropriate cleanup level, (3) the 2001 and 2005 dispute resolutions (Attachments 1A and 1B of this document) are applicable to the VOC ROD remedy, (4) SVE removal actions will be incorporated into the VOC ROD remedy, and (5) SVE START/STOP process will be incorporated into the VOC ROD remedy.

A separate ROD will be prepared for non-VOC contamination in the groundwater. Limited treatment capability for a non-VOC constituent, hexavalent chromium, is already in place to meet surface water discharge substantive requirements. An ion-exchange treatment system installed in 2003 is capable of treating up to 750 gallons per minute. Hexavalent chromium in groundwater is the result of past manufacturing processes; however, hexavalent chromium is also naturally occurring. The upgraded treatment system has enabled McClellan to meet the discharge limits to surface water for the GWTP.

2.11.2 Soil Vapor Extraction

VOCs may be remediated directly in the vadose zone or in the groundwater. On a per pound basis, removing VOCs from the vadose zone is less costly and technically simpler than removing VOCs from the groundwater. SVE is used to remove and treat VOC sources in the vadose zone that constitute threats to groundwater. This ROD addresses SVE systems designed to treat VOCs in the vadose zone that might migrate to groundwater, thereby

compounding or prolonging the groundwater cleanup process. The shallow soil gas inhalation pathway is not covered under this ROD, but is being addressed by separate RODs.

Under the Selected Remedy, SVE will be completed at the existing systems that were installed as removal actions. To-date, 14 SVE systems have been installed at McClellan, with many of these systems treating multiple sites. No additional SVE systems are planned at this time, however the existing systems will be expanded and new systems installed if necessary. Locations of the existing SVE systems are shown on Figure 3. The vadose zone component of the Selected Remedy includes treatment of the extracted soil gas by carbon adsorption or oxidation. At some locations, treatment of the extracted soil gas is not required and the soil gas is discharged directly into the atmosphere. Treatment methods may change as conditions change or new and improved technologies become available. The current procedures for operation and monitoring of the extraction and treatment systems are provided in the Basewide Removal Action Work Plan for Soil Vapor Extraction (URSG-Laidlaw, 2001) and the Addendum to the Basewide SVE Removal Action Work Plan (URS, 2004). These documents also provide specific procedures and frequencies for the monitoring of soil vapor extraction and monitoring wells.

A number of factors must be evaluated to arrive at the decision to install and operate an SVE system. These factors are identified in separate papers, referred to as the START and STOP processes, to determine when individual SVE systems are to be turned on or off, respectively. The START and STOP processes were developed and agreed to by the Air Force and regulatory agencies in 2001 as part of the dispute resolution (see Attachment 2). The processes will be used on a site-by-site or plume-by-plume basis.

2.11.3 Institutional Controls

Institutional controls are a component of the Selected Remedy. Institutional controls are non-engineering, non-technical mechanisms used to reduce or prevent human exposure to contaminants. The institutional control objectives are to:

- Prevent extraction of the groundwater for any purpose other than remediation or monitoring
- Prevent disturbances of any equipment or systems associated with groundwater remediation or monitoring
- Preserve access to any equipment or systems associated with groundwater remediation or monitoring for the Air Force and regulatory agencies

Institutional controls are selected for all property overlying the VOC groundwater contaminant plumes. Use of groundwater will be prohibited on onbase property overlying groundwater with VOC concentrations exceeding MCLs through deed covenants and the SLUC. In addition, the use of groundwater is restricted within 2,000 feet of the groundwater contamination (on and off base) through the consultation zone implemented by Sacramento County ordinance (see Section 2.6). Figure 11 shows the onbase and offbase VOC plumes as of the fourth quarter 2005, along with the institutional controls for those plumes.

Specific language is included in this ROD regarding implementing, monitoring, reporting and enforcing institutional controls. Therefore, compliance with the terms of this ROD will

be protective of human health and the environment. Because the restrictions and the means for implementing the restrictions are specifically described in the following subsections, it is not necessary for the Air Force to submit any new, post-ROD institutional control implementation documents, such as a Land Use Control Implementation Plan, new operation and maintenance plans, or remedial action work plans.

The institutional control alternative includes an enforceable use restriction and institutional control on the use of certain properties (land overlying a plume exceeding an MCL). The Air Force is responsible for implementing, maintaining, enforcing, reporting, and monitoring the remedial actions (including the institutional controls) before and after property transfer. The Air Force will exercise this responsibility in accordance with CERCLA and the National Contingency Plan.

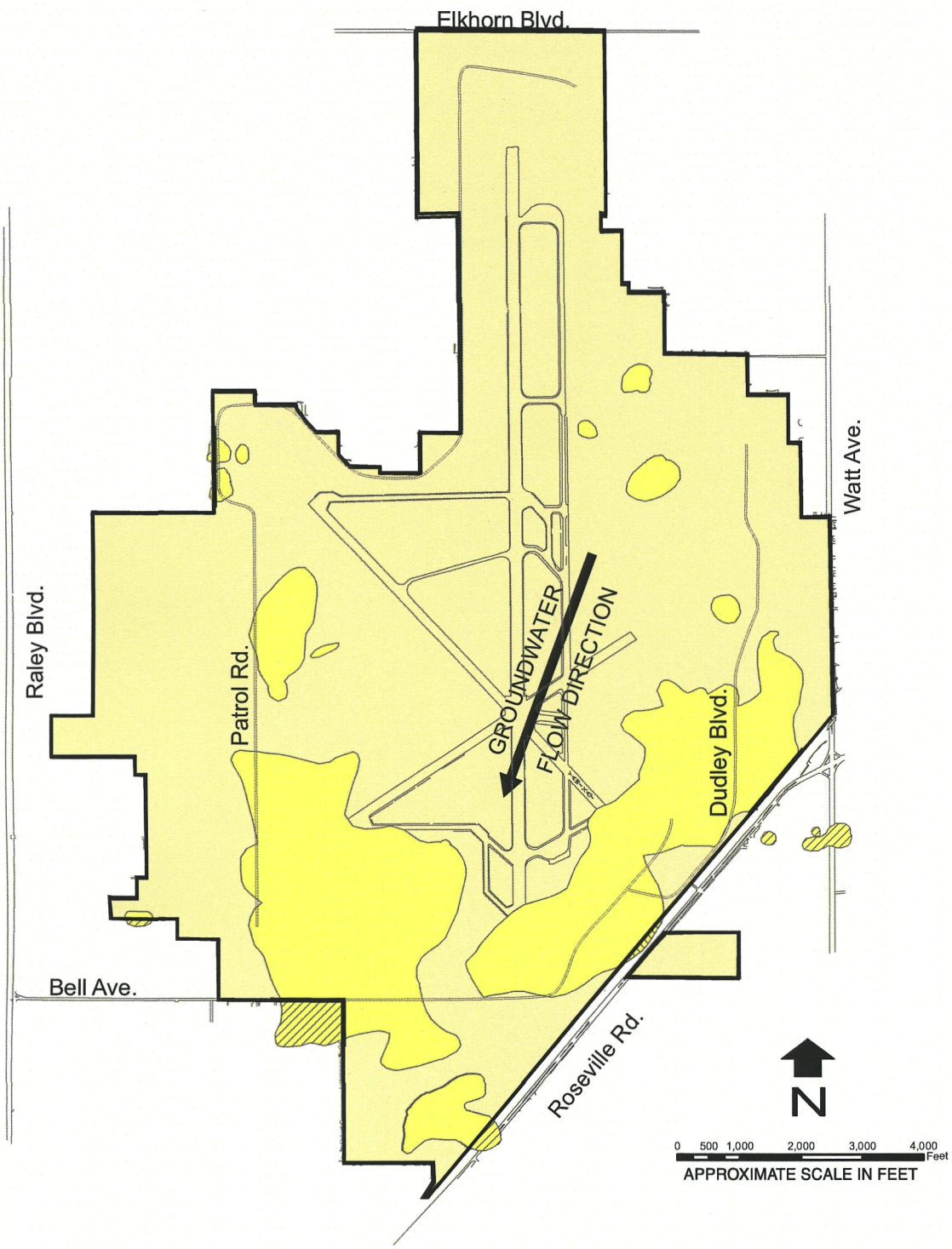
Meeting the RAO shall be the primary and fundamental indicator of institutional control performance, the ultimate aim of which is to protect human health and the environment. Performance measures for institutional controls are the RAO plus the actions necessary to achieve those objectives. It is anticipated that successful implementation, operation, maintenance and completion of these measures will achieve protection of human health and the environment and compliance with all legal requirements.

The Air Force may contractually arrange for third parties to perform any of the actions associated with institutional controls, although the Air Force is ultimately responsible under CERCLA for the successful implementation of institutional controls, including monitoring, maintenance and review of institutional controls. Monitoring, maintenance and other controls as established in accordance with this ROD and the appropriate transfer documents will be continued until institutional controls are no longer necessary. The institutional controls will remain in effect after MCLs are achieved while the parties examine the potential for achieving the 2.3 ppb TCE level, as described in Section 2.11.1.

Certain parcels of property encompassing plumes exceeding an MCL are currently leased to Sacramento County. Groundwater use restrictions equivalent to those specified in this ROD are currently promulgated by lease terms. The lease restrictions are in place and operational and will remain in place until the property is transferred by deed. At the time of deed transfer, lease restrictions will be superseded by equivalent restrictions to be included in the Federal deed and the SLUC as described in this ROD.

Deed Restriction and Reservation of Access

The Federal deed(s) for any property overlying a plume exceeding an MCL will include a description of the residual contamination on the property, consistent with the Air Force's obligations under CERCLA Section 120(h) and the specific restrictions set forth in this Section. The Federal deeds may require additional specific restrictions from RODs addressing other residual contamination on the property. Institutional controls, in the form of deed restrictions, are "environmental restrictions" under California Civil Code Section 1471 (Section 1471). The deeds will include legal description of the affected area and will contain the provisions and specific language required by Section 1471 to qualify the institutional controls as "environmental restrictions" so that they run with the land.



Legend

On-base contamination above drinking water standards where the institutional controls will be applied primarily through deed restrictions and the State Land Use Covenant (SLUC), as described in Section 2.11.3.

Off-base contamination above drinking water standards where the institutional controls will be applied through the existing groundwater use prohibition areas and the consultation zone, shown on Figures 8 and 9, respectively, and described in more detail in Section 2.6.

FIGURE 11
AREA FOR GROUNDWATER INSTITUTIONAL CONTROLS
BASEWIDE VOC GROUNDWATER ROD
FORMER McCLELLAN AIR FORCE BASE
SACRAMENTO, CALIFORNIA

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The Air Force and regulatory agencies may conduct inspections of institutional controls and the affected property. The deeds will also contain a reservation of access to the property for the Air Force, the EPA, and the State and their respective officials (i.e., both RWQCB and DTSC), agents, employees, contractors and subcontractors for purposes consistent with the Air Force Installation Restoration Program or the Federal Facilities Agreement. The Air Force will provide such access to regulatory agencies prior to transfer.

The environmental restrictions are the basis for part of the CERCLA 120(h)(3) covenant that the United States is required to include in the deed for any property that has had hazardous substances stored for one year or more or known to have been released or disposed of on the property.

For any deed (non-Federal entity) or letter of transfer (Federal entity) transferring all or part of any parcel overlying a plume exceeding an MCL, institutional controls, in the form of land use restrictions, will be incorporated in the deed as a grantee covenant, in substantially the following language:

- Grantee covenants and agrees that it will not extract groundwater from the property for any purpose other than monitoring.
- Grantee covenants and agrees that it will not conduct or allow others to conduct activities that would cause disturbance of any equipment or systems associated with groundwater remediation or monitoring.
- Grantee covenants and agrees that it will not conduct or allow others to conduct activities that would limit access to any equipment or systems associated with groundwater remediation or monitoring.

When MCLs have been achieved, only those restrictions needed to permit additional cleanup to 2.3 ppb of TCE would be retained, either until such time as the decision is made not to proceed to that cleanup level, or, if the 2.3 ppb cleanup level is approved, until such time as it is achieved.

The transfer document(s) will also include a condition that the transferee execute and record a SLUC, within 10 days of transfer, to address any State obligations pursuant to State law, including 22 California Code of Regulations (CCR), Section 67391.1. The letters of transfer will include a condition that any future deeds to a non-Federal entity include this requirement.

Notice of Institutional Control

The Air Force will include the specific deed restriction language set forth in this ROD in the deed for any parcel that overlies a plume exceeding an MCL, and will provide a copy of the deed(s) to regulatory agencies as soon as practicable after the transfer of fee title. The Air Force will inform the property owner(s) of the necessary institutional controls by providing the draft deed(s) in advance of transfer. The signed deed will also include the specific land use restrictions, and the signed deed, or another enforceable transfer document, will contain a condition that the transferee execute and record a SLUC, within 10 days of property transfer, to address any State obligations pursuant to State law, including 22 CCR, Section 67391.1. The Air Force will ensure that the transferee has met this condition. Concurrent with the transfer of fee title from the Air Force to transferee, the

Finding of Suitability for Transfer or the Finding of Suitability for Early Transfer and location of the Administrative Record file will be communicated in writing to the property owners and the State to ensure State agencies can factor such conditions into their oversight and decision-making activities regarding the property.

Prior to conveyance of any Air Force property overlying a plume exceeding an MCL, EPA and State representatives will be given reasonable opportunity to review and comment on the applicable deed language and associated rights of entry for the agencies for institutional control oversight and enforcement. The Air Force will provide notice to the EPA and the State of California at least six (6) months prior to any transfer or sale of property containing land use controls so that EPA and State of California can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective land use controls. If it is not possible for the facility to notify EPA and the State of California at least six months prior to any transfer or sale, then the facility will notify EPA and the State of California as soon as possible but no later that 60 days prior to the transfer or sale of any property subject to land use controls. Additionally, the Air Force further agrees to provide EPA and the State of California with similar notice, within the same time frames, as to Federal-to-Federal transfer of property accountability. The Air Force shall provide either access to or a copy of the executed deed or other transfer documentation to the EPA and the State of California.

Annual Evaluations/Monitoring

Prior to property transfer, the Air Force will conduct annual monitoring, provide annual reports and undertake prompt action to address activity that is inconsistent with the institutional control objective or use restrictions, or any action that may interfere with institutional control effectiveness. The institutional control annual evaluations will be included in a separate report or as a section of another environmental report (e.g., annual groundwater monitoring report), which are provided to the EPA and the State. The annual monitoring report will evaluate the status of the institutional controls and how any institutional control deficiencies or inconsistent uses have been addressed. The annual evaluation will address whether the use restrictions and controls referenced above were communicated in the deed(s), whether the owners and State and local agencies were notified of the use restrictions and controls affecting the property, and whether use of the property has conformed with such restrictions and controls. The annual monitoring reports will be used in preparation of five-year reviews to evaluate the remedy's effectiveness. Prior to transfer, the annual monitoring report submitted to regulatory agencies by the Air Force will evaluate the status of institutional controls and how any institutional control deficiencies or inconsistent uses have been addressed.

Upon the effective date of property conveyance, the transferee[1] or subsequent property owner(s) will conduct annual physical inspections of property overlying an MCL plume to confirm continued compliance with all institutional control objectives unless and until the institutional control at the site is terminated. The transferee or subsequent property owner(s) will provide to the Air Force, the EPA, and the State of California an annual monitoring report. The annual monitoring report will evaluate the status of the institutional control and how an institutional control deficiency or inconsistent use has been addressed.

[1] Or other entity accepting such obligations (which may include, without limitation, subsequent transferees)

The annual evaluation will address whether use of the property has conformed to restrictions and controls affecting the property. The Air Force will place these transferee obligations in the transfer documentation.

The five-year reviews conducted by the Air Force will also address whether the institutional control in the ROD was inserted in the deed, if property was transferred during the period covered, whether the owners and State and local agencies were notified of the institutional control affecting the property and whether use of the property has conformed to such an institutional control. Five-year review reports will make recommendations on the continuation, modification, or elimination of annual reports and institutional control monitoring frequencies. Five-year review reports are submitted by the Air Force to regulatory agencies for review and comment.

Although the Air Force may transfer these procedural responsibilities to the transferee and its successors by provisions to be included in the deed(s) and may contractually arrange for third parties to perform any and all of the actions associated with the institutional control, the Air Force is ultimately responsible for the remedy and shall retain ultimate responsibility for remedy integrity.

Response to Violations

Prior to property transfer, the Air Force will notify the EPA and the State as soon as practicable but no longer than 10 days after discovery of any activity that is inconsistent with the institutional control objectives or use restrictions or any action that may interfere with the effectiveness of the institutional controls. The Air Force will notify the EPA and the State regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and the State notification of the breach.

The deed will require that post transfer, the transferee will notify the Air Force, the EPA, and the State of any activity that is inconsistent with the institutional control objectives or use restrictions, or any other action that may interfere with the effectiveness of the institutional controls, and will address such activity or condition as soon as practicable, but in no case will the process be initiated later than 10 days after the transferee becomes aware of the breach. If the transferee fails to satisfy its obligations pursuant to the SLUC, DTSC or the RWQCB may enforce such obligations against the transferee. If there is failure of the selected remedy or a violation of selected remedy obligations (for example, an activity inconsistent with institutional control objectives or use restrictions, or any action that may interfere with the effectiveness of the institutional control), DTSC will notify the Air Force, the EPA, and the RWQCB in writing of such failure as soon as practicable (but no longer than 14 days) upon discovery of the inconsistent activity or action that interferes with the effectiveness of the institutional control, and initially seek corrective action or other recourse from the transferee, including recovery of its associated costs. If, after diligent efforts, the State is unable to enforce the obligations of the SLUC or remedy obligations against the transferee, within 21 days following DTSC's notification, the parties shall confer to discuss re-implementation of the selected remedy or other necessary remedial actions to address the breach of the institutional control. Once DTSC reports that the transferee is unwilling or unable to undertake the remedial actions, the Air Force will, within 10 days, inform the other parties of measures it will take to address the breach. Costs incurred by the State in undertaking regulatory oversight of remedies re-implemented by the Air Force will be addressed using funding appropriated to the Department of Defense to pay such costs.

Approval of Land Use Control Modification

The Air Force shall not modify or terminate land use controls or implementation actions that are part of the selected remedy, or modify land use without approval by the EPA and the State. The Air Force shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the land use control or any action that may alter or negate the need for land use controls.

Any grantee of property constrained by an institutional control imposed through their transfer document(s) may request modification or termination of the institutional control. Modification or termination of the institutional control, except the SLUC (discussed below), requires Air Force, EPA and State approval. Prior to seeking approval from the EPA and the State, the recipient of the property must notify and obtain approval from the Air Force of any proposals for a land use change at a site inconsistent with the use restrictions and assumptions described in this ROD.

State Land Use Covenant Modification

Any modification or termination of the SLUC must be undertaken in accordance with State law and will be the responsibility of the transferee or then-current owner or operator.

2.11.4 Summary of Estimated Remedy Costs and Cleanup Timeframe

A detailed cost estimate for all alternatives, including Alternative 2B, was included in the 1999 Basewide VOC FS in Appendix E, Tables E-1 to E-10 (CH2M HILL, 1999). The detailed cost estimate provided in the VOC FS was supplemented by an estimate provided in the FS Addendum of the cost of implementing institutional controls.

Recently, cost estimates have been revised to reflect the current conceptual site model (stabilized water table elevation at approximately 100 feet bgs) and output from the new fate and transport model. As predicted using the model, all VOC concentrations in groundwater will be reduced below the MCL in 55 years. The total estimated cost is $72 million and the estimated present worth cost is $53 million (see Table 6). These values exclude the capital, O&M, and monitoring costs for the period between 1997 and 2006 that were included in the original VOC FS cost estimate. This is an order-of-magnitude engineering cost estimate that is expected to be within plus 50 percent to minus 30 percent of the project cost.

2.11.5 Summary of the Rationale for the Selected Remedy

Alternative 2B is believed to be the best option to cleanup groundwater and reduce risk. The No Action alternative achieves less risk reduction, but the other alternatives achieve the same level of protectiveness with the implementation of institutional controls with respect to current, as opposed to hypothetical, risk. The cost and time to complete cleanup for Alternative 2B have been recently revised based on a groundwater model (Three-Dimensional Flow and Fate and Transport Model Technical Memorandum, June 2006 [URS, 2006a]). The changes in cost and time to clean up for the other alternatives that also rely on groundwater extraction are expected to be proportional to the changes to those estimated quantities for Alternative 2B. All of the alternatives other than No Action cost substantially more and take longer to complete than 2B. The Air Force prefers Alternative 2B because the extra cost and time associated with the other alternatives cannot be justified for the small additional reduction in hypothetical risk.

TABLE 6
Revised Cost Estimate for Alternative 2B
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

	Soil Vapor Extraction		Groundwater Extraction, Treatment, and Monitoring						
					Wellfield O&M				
Year	Capital	O&M	GWTP O&M	Monitoring[a]	Zone A	Zone B	Zone C	Zone D	Annual Cost (2006 Dollars)
2007-2011	$0	$3,009,000	$862,935	$1,395,541	$264,059	$44,687	$24,375	$0	$5,600,597
2012-2016	$0	$1,650,000	$749,620	$1,212,288	$229,385	$38,819	$21,174	$0	$3,901,286
2017-2021	$0	$0	$522,991	$845,782	$160,036	$27,083	$14,773	$0	$1,570,665
2022-2026	$0	$0	$331,228	$535,662	$101,356	$17,153	$9,356	$0	$994,754
2027-2031	$0	$0	$217,913	$352,409	$66,682	$11,285	$0	$0	$648,288
2032-2041	$0	$0	$139,464	$225,542	$42,676	$0	$0	$0	$407,682
2042-2051	$0	$0	$104,598	$169,156	$32,007	$0	$0	$0	$305,762
2052-2061	$0	$0	$61,016	$98,675	$18,671	$0	$0	$0	$178,361
Total	**$0**	**$23,295,000**	**$16,474,212**	**$26,642,148**	**$5,041,132**	**$695,130**	**$348,386**	**$0**	**$72,496,009**
								PW_{55}[b] =	**$53,971,656**

[a]Including cost of institutional controls
[b]Calculated using a 3 percent discount rate

Notes:

All costs in 2006 dollars

PW = present worth cost

Based on information currently available, Alternative 2B protects human health and the environment, complies with ARARs, is cost-effective and utilizes permanent solutions and, to the extent practicable, the most effective, currently usable treatment technologies.

2.11.6 Expected Outcomes

Cleanup levels for VOCs in groundwater are documented in this section. In addition, for SVE, the processes used to decide whether to install a system and to discontinue operation of a system are discussed.

Groundwater

The groundwater cleanup standard for TCE and other VOCs is the MCL. For TCE, the MCL is 5 µg/L. As specified in the 2001 Dispute Resolution (see Attachment 1A):

> The Record of Decision will state 5 ppb as the cleanup standard for TCE. The parties agree to proceed with cleanup as proposed by the Air Force until such time as 5 ppb is achieved in each plume, as defined by the BRAC cleanup team. At that point, the Air Force, in collaboration with the State and EPA Remedial Project Managers, agrees within 60 days to complete an analysis and prepare a report (using agreed upon models) which evaluate the technical and economic feasibility of continuing remediation until plume levels reach 2.3 ppb TCE. After the report is complete, the parties will have another 30 days to reach an agreement. If an agreement cannot be reached, the Air Force may shut off the wells and any party may use the dispute resolution provisions of the Federal Facilities Agreement.

MCLs are enforceable standards applicable to public water supply systems. In CERCLA groundwater cleanups, MCLs are generally relevant and appropriate for determining acceptable exposure limits for groundwater that is a current or potential source of drinking water (40 CFR 300.430(e)(2)(i)(B)). For those VOCs present in groundwater at concentrations exceeding their MCLs, the MCLs are listed in Table 2.

The designated beneficial use of groundwater in the aquifers beneath McClellan is domestic or municipal water supply. Upon attaining the VOC cleanup levels groundwater could be extracted for this purpose. The time to clean up is predicted by the revised groundwater model to be 55 years for the Selected Remedy. The Air Force will continue to collect groundwater monitoring data that will be used during technical evaluations of the remedy's effectiveness.

Vadose Zone

Specific cleanup standards for VOCs in the vadose zone for protection of groundwater are not defined. Instead, the site-specific START and STOP processes (provided in Attachment 2) will be used to determine whether to install a system and when to discontinue operation of a system, respectively.

2.12 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

2.12.1 Protection of Human Health and the Environment

The Selected Remedy (Alternative 2B) will protect human health and the environment through the treatment of VOC-contaminated soil by SVE and by extracting and treating groundwater. The Selected Remedy will remove VOCs to drinking water standards and prevent the VOCs in groundwater from migrating to groundwater users beyond the delineated plume.

The Selected Remedy will also minimize the potential for recontamination of groundwater from VOCs in the vadose zone. Any short-term threats associated with the Selected Remedy can be readily controlled. In addition, no adverse cross-media impacts are expected from the Selected Remedy.

2.12.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy of in situ SVE and extracting the groundwater and treating by air stripping and carbon adsorption complies with all ARARs. The groundwater treatment system was constructed as an interim remedial action under a previous IROD, and a number of SVE systems were constructed as removal actions under Engineering Evaluation/Cost Analysis (EE/CA) documents. Any additional SVE systems will be constructed in accordance with the ARARs identified in this ROD. The action-specific, chemical-specific, and location-specific ARARs identified by the Air Force are presented in Tables 7A, 7B, and 7C, respectively.

The following text regarding ARARs was developed by the Air Force and the regulatory agencies to resolve the 2001 dispute as documented in the Dispute on McClellan Air Force Base VOC Proposed Plan, Level 3 Consensus Statement to Resolve Issues No. 4 and 5 dated 08 March 2001 (provided as Attachment 1D to this ROD).

Air Force Position

It is the position of the Air Force that California State Water Resources Control Board Resolutions 68-18 and 92-49 and Basin Plan policies do not meet the National Contingency Plan (NCP) criteria for potential applicable or relevant and appropriate requirements (ARARs) and thus are not ARARs for establishing groundwater cleanup standards for McClellan AFB. The State has not demonstrated that these resolutions and policies, as defined by the State in the context of this cleanup, meet the NCP criteria of enforceability and general applicability. In the alternative, if some or all of the resolutions and policies were redefined by the State to meet the NCP criteria of

TABLE 7A
Action-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Action: Groundwater Remediation	Requirement	ARAR Determination	Description of Requirement	Comments
Safe Drinking Water Act				
	Federal MCLs found in 40 CFR Section 141, Subparts B and G*	Relevant and Appropriate	National primary drinking water standards are health-based standards for public water systems (i.e., MCLs). The NCP defines MCLs as potentially relevant and appropriate for groundwater determined to be a current or a potential source of drinking water in cases where MCL goals are not ARARs.	Groundwater in the vicinity of McClellan AFB has been designated for drinking water use. See Table 7B.
	40 CFR Section 141, Subpart F	Relevant and Appropriate	MCL goals that have non-zero values are relevant and appropriate for groundwater determined to be a current or a potential source of drinking water [40 CFR 300.430(e)(2)(i)(B) through (D)].	Groundwater in the vicinity of McClellan AFB has been designated for drinking water use. Non-zero MCL goals exist for some of the contaminants of potential concern (see Table 7B).
	State MCLs found in 22 CCR Section 64435 and Section 64444.5	Relevant and Appropriate	Like Federal MCLs, State MCLs are relevant and appropriate as cleanup goals for groundwater determined to be a current or a potential drinking water source.	State MCLs are relevant and appropriate only if they are more stringent than Federal MCLs.
Clean Water Act – National Pollutant Discharge Elimination System (NPDES) Program				
	NPDES discharge requirements (only the substantive requirements are considered ARARs)	Relevant and Appropriate	New discharges of treated groundwater to Magpie Creek and Beaver Pond must comply with the substantive portions of the NPDES permit program. These levels are functionally equivalent to the waste discharge requirements that would otherwise be issued in a NPDES permit from the RWQCB.	
	California Toxics Rule 40 CFR Part 131	Applicable	Water quality standards: The California Toxics Rule establishes permit limits for new or revised NPDES permits when certain conditions are met. Applies to the discharge of treated groundwater from the GWTP into surface waters, in this case, Magpie and Don Julio Creeks and Beaver Pond.	This establishes criteria for surface water quality; therefore, it is applicable to discharge of treated groundwater.

TABLE 7A
Action-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Action: Groundwater Remediation	Requirement	ARAR Determination	Description of Requirement	Comments
	33 United States Code (USC) Section 1313	Relevant and Appropriate	Water quality standards and implementation plans: directs the EPA and states to develop water quality standards, to assess the status of their waters to determine whether the standards are sufficiently protective of water quality and whether they are being met, and to have an ongoing planning process for assessing water quality and revising the standards if needed.	
Concentration Limits ARARs (supporting authorities)				
	State Water Resources Control Board Resolution 92-49, Section III.G	Relevant and Appropriate (State believes this is an applicable requirement.)	Section III.G states in part that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of background water quality, or the best water quality that is reasonable if background levels cannot be restored.	
	State Water Resources Control Board Resolution 68-16	Applicable	Requires that discharges to waters meet waste discharge requirements to ensure that pollution or nuisance will not occur and the highest water quality consistent with maximum benefit to the State will be maintained.	Discharge of treated groundwater to surface water or surface water drainage courses must take into account the protection of beneficial uses and maintenance of high-quality waters in the area.
	Narrative Toxicity Standard in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins	Relevant and Appropriate (State believes this is an applicable requirement.)	Chapter III, Narrative Toxicity Objective, states as a policy that all waters shall be maintained free of toxic substances that produce detrimental physiological responses in human, plant, animal, or aquatic life.	

TABLE 7A
Action-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Action: Groundwater Remediation	Requirement	ARAR Determination	Description of Requirement	Comments
Groundwater and environmental monitoring	23 CCR 2510(g)	Relevant and Appropriate	Groundwater monitoring may be required if wastes that were discharged to waste management units at McClellan AFB prior to November 27, 1984, threaten groundwater quality.	
	Substantive requirements of 22 CCR 66264.100, with the exception to references made to groundwater protection standards	Relevant and Appropriate	Requirements for the implementation of corrective action measures are relevant and appropriate because wastes that have been discharged to land (source areas) have caused groundwater contamination. Corrective action shall include water quality monitoring to demonstrate the effectiveness of the corrective action.	
	Substantive requirements of 22 CCR 66264.90, et seq.	Relevant and Appropriate	Establishes general requirements for groundwater monitoring systems for hazardous waste facilities.	These regulations require general water quality monitoring of groundwater at McClellan AFB. The intent of these requirements is currently being met under the existing groundwater monitoring program.
	Substantive requirements of 22 CCR 66264.700, et seq.	Relevant and Appropriate	Establishes requirements for environmental monitoring systems for hazardous waste facilities.	May be relevant and appropriate to SVE or groundwater treatment units.
Hazardous waste identification and handling	22 CCR 66262.10(a) and 66262.11	Applicable	Requirements for the identification and accumulation of hazardous waste are applicable to hazardous wastes (i.e., extracted groundwater and treatment system O&M wastes) generated during the implementation of the remedial alternative.	These requirements are applicable to hazardous wastes that are generated, containerized, and stored onsite, such as treatment unit residuals from the groundwater treatment system or SVE systems.
	22 CCR 66262.30 through 66262.34	Applicable	Prior to transportation, containers should be accumulated, packaged, labeled, marked, and placarded in accordance with Resource Conservation and Recovery Act (RCRA) and Department of Transportation requirements.	These requirements are applicable to containers that are used to contain hazardous wastes such as treatment residuals and are sent offsite for disposal.

TABLE 7A
Action-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Action: Groundwater Remediation	**Requirement**	**ARAR Determination**	**Description of Requirement**	**Comments**
Construction of groundwater and SVE wells and treatment systems	40 CFR Parts 122, 123, 124, NPDES, implemented by State Water Resources Control Board Order 92-08 DWQ	Applicable	Regulates pollutants in discharge of stormwater associated with construction activity (clearing, grading, or excavation) involving the disturbance of 1 acre or more. Requirements to ensure stormwater discharges do not contribute to a violation of surface water quality standards.	Substantive requirements only apply to construction activities during installation and construction of groundwater and SVE wells and treatment systems. However, no significant construction activities are anticipated.
Container storage	22 CCR 66264.171, 172, 173, 174	Applicable	*Containers of RCRA hazardous waste must:* • Be maintained in good condition. • Be compatible with hazardous waste to be stored. • Be closed during storage except to add or remove waste. • Have adequate secondary containment when stored onsite	*These requirements are applicable to* hazardous wastes that are generated, containerized, and stored at the site, such as treatment unit residuals from the groundwater treatment system or SVE systems.
	22 CCR 66264.175(a) and (b)	Applicable	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide a containment system with a capacity of 10 percent of the volume of containers with liquids. Remove spilled or leaked waste in a timely manner to prevent overflow of containment system.	These requirements are applicable to hazardous wastes that are generated, containerized, and stored onsite, such as treatment unit residuals from the groundwater treatment system or SVE systems.
	22 CCR 66264.176	Relevant and Appropriate	Special requirements for ignitable or reactive waste: Containers holding ignitable or reactive waste shall be located at least 15 meters (50 feet) from the facility's property line.	Ignitable or reactive waste will not be generated during the remedial action.

TABLE 7A
Action-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Action: Groundwater Remediation	Requirement	ARAR Determination	Description of Requirement	Comments
	22 CCR 66264.177	Relevant and Appropriate	Special requirements for incompatible wastes: • Incompatible wastes, or incompatible wastes and materials, shall not be placed in the same container unless Section 66264.17(b) is complied with. • Hazardous waste shall not be placed in an unwashed container that previously held an incompatible waste or material. • A container holding a hazardous waste that is incompatible with any waste or other materials transferred or stored nearby in other containers, piles, open tanks, or surface impoundments shall be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.	Incompatible wastes will not be generated during the remedial action.
	22 CCR 66264.178	Relevant and Appropriate	At closure, all hazardous waste and hazardous waste residues shall be removed from the containment system. Remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues shall be decontaminated or removed. At closure, unless the owner or operator can demonstrate that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and shall manage it in accordance with all applicable requirements.	
Treatment of hazardous waste in tanks	22 CCR 66264.192, 193, 194, and 196 (40 CFR 264.192, -.193, -.194, and -.196)	Relevant and Appropriate	These regulations include requirements that ensure that tanks and ancillary equipment are adequately designed, operated, and maintained to ensure that the tank system would not fail.	Substantive portions of these requirements are relevant and appropriate to tanks that are used as equalization tanks for groundwater influent or that are used to collect condensate from SVE treatment units.

TABLE 7A
Action-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Action: Groundwater Remediation	Requirement	ARAR Determination	Description of Requirement	Comments
Treatment of hazardous waste in miscellaneous units	Substantive requirements of 22 CCR 66264.601 (40 CFR 264.601)	Relevant and Appropriate	These regulations include design, operation, maintenance, and closure requirements for miscellaneous treatment units used to treat hazardous waste.	These requirements are relevant and appropriate to air strippers.
Control of emissions from process vents and pressure relief devices	22 CCR 66264.1032(a) [40 CFR 2644.1032(a)]	Relevant and Appropriate	Sets operating and performance standards for air emissions from process vents associated with facilities that treat hazardous wastes with organic concentrations of at least 10 parts per million (ppm) by weight.	Relevant and appropriate if the groundwater or soil vapor that is treated is expected to contain organic concentrations of at least 10 ppm by weight.
Control of emissions from pressure relief devices	22 CCR 66264.1054	Relevant and Appropriate	Pressure relief devices in gas/vapor service shall be operated with no detectable emissions, as indicated by an instrument reading less than 500 ppm above background.	Relevant and appropriate if such devices are used with SVE systems and if the device does not have its own vapor recovery system.
Control of Air Emissions	Sacramento Metropolitan Air Quality Management District (SMAQMD) Rule 201	Applicable	Requires sources of air emissions to obtain permits to operate.	Substantive requirements of air permits would apply if 2 pounds per day or more of air emissions would occur from onsite treatment systems. These requirements could include operational restrictions, such as emission limits.
	SMAQMD Rule 202, Section 302	Applicable	Requires Best Available Control Technology to be applied to new emissions. Offsets for new emissions may be required.	The GWTP was previously constructed under the IROD. New emissions are not anticipated.
	SMAQMD Rule 402 (as promulgated)	Applicable	Emissions from a new GWTP may not cause injury, detriment, nuisance, or annoyance to the public, businesses, or property.	
	SMAQMD Rule 403	Applicable	Fugitive dust control standards must be met within the areal extent of contamination during any construction activities as a result of implementing the remedial actions.	

TABLE 7A
Action-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Action: Groundwater Remediation	Requirement	ARAR Determination	Description of Requirement	Comments
Deed restrictions and SLUC	22 CCR 67391.1(a), (d), and (e)	Relevant and Appropriate	Requires imposition of appropriate limitation on land use by recorded land use covenant (LUC) when hazardous substances remain on the property at levels that are not suitable for unrestricted use of the land. Requires that the LUC be recorded in the county where the land is located.	The same restrictions (in the form of institutional controls) will be included in the Federal deed and a SLUC.
	CA Civil Code Sect. 1471(a) and (b)	Relevant and Appropriate	Specifies requirements for LUC to apply to successors in the title to the land.	

Note:

* To identify ARARs, the designation of the beneficial use for the aquifer must be determined. SWRCB Resolution 88-63 (Sources of Drinking Water Policy) as implemented in the RWQCB's Water Quality Control Plan establishes that with certain exceptions all groundwater and surface waters have the beneficial use of municipal and domestic water supply. The State believes that Resolution 88-63 is an ARAR. The Air Force believes that while Resolution 88-63 is not an ARAR, it is an essential predicate for the establishment of drinking water ARARs.

TABLE 7B
Chemical-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

	ARAR				
	Safe Drinking Water Act or State Equivalent		RCRA		
Potential Contaminant of Concern	**Primary MCL (µg/L)**	**Non-zero MCL Goals (µg/L)**	**TCLP (µg/L)**	**STLC (mg/L)**	**TTLC (mg/kg)**
1,2-dibromoethane	0.05	-	-	-	-
1,1-dichloroethane	5*	-	-	-	-
1,1-dichloroethene	6*	7	700	-	-
1,2-dichloroethane	0.5*	-	500	-	-
1,1,2-trichloroethane	5	3	-	-	-
Benzene	1*	-	500	-	-
Carbon tetrachloride	0.5*	-	500	-	-
Chloroform	80	-	6,000	-	-
cis-1,2-Dichloroethene	6*	70	-	-	-
Methylene chloride (dichloromethane)	5	-	-	-	-
PCE	5	-	700	-	-
TCE	5	-	500	204	2,040
Vinyl chloride	0.5*	-	200	-	-

* California MCL that is more stringent than the Federal MCL.

Notes:

µg/L = micrograms per liter
mg/L = milligrams per liter
mg/kg = milligrams per kilogram
TCLP = Toxicity Characteristic Leaching Procedure
TTLC = Total Threshold Limit Concentration
STLC = Soluble Threshold Limit Concentration

TABLE 7C
Location-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Location	Requirement	Description	ARAR Determination	Comments
Within 100-year flood plain	22 CCR 66264.18(b)	A RCRA facility located in a 100-year flood plain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood.	Relevant and Appropriate	Portions of McClellan AFB are located in the 100-year flood plain. No new permanent building is proposed in the 100-year flood-plain zone.
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	National Archaeological and Historical Preservation Act (16 USC Section 469); 36 CFR Part 65	Alteration of terrain that threatens significant scientific, prehistoric, historic, or archaeological data may require actions to recover and preserve artifacts.	Applicable	The remedial action has already been constructed and will not alter or destroy any known prehistoric or historic archaeological features at the McClellan AFB site.
Historic project owned or controlled by a Federal agency	National Historic Preservation Act Section 106 (16 USC Section 470 et seq); 36 CFR Part 800	Property included in or eligible for the National Register of Historic Places may require action to preserve historic properties.	Applicable	If historic properties are impacted during the implementation of the remedial action, these requirements are applicable. However, the remedial action has already been constructed with no impact to historical properties.
Critical habitat upon which endangered species or threatened species depend	Substantive portions of the Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Parts 200, 222, 226, 227, and 402 California Endangered Species Act (Fish and Game Code 2050 et seq) Substantive portions of the Native Plant Protection Act	Requires action to conserve endangered species or threatened species, including consultation with the Department of the Interior, Fish and Wildlife Service.	Applicable	Two endangered floral species are known to occur within Sacramento County: the Sacramento Orcutt grass (*Orcuttia viscida*) and the Boggs Lake hedge hyssop (*Gratiola heterosepala*). Four endangered wildlife species are expected to occur within 25 miles of McClellan AFB: Bald Eagle, Peregrine Falcon, Giant Garter Snake, and the Valley Elderberry Longhorn Beetle. McClellan AFB may be a habitat for the Burrowing Owl, a species of concern in California. Consultations between DTSC and Department of Fish and Game will be conducted if such species are affected by remedial actions. However, the remedial action has already been constructed with no impact to threatened or endangered species.

TABLE 7C
Location-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Location	Requirement	Description	ARAR Determination	Comments
Wetlands	Fish and Game Commission Wetlands Policy (adopted 1987) included in Fish and Game Code Addenda	Actions must be taken to ensure that "no net loss" of wetlands acreage or habitat value occurs. Actions must be taken to restore and enhance California's wetland acreage and habitat value.	TBC	This policy is not a regulatory program and will be considered as a TBC material if future construction is required.
	40 CFR Part 6 Appendix A	Actions must be taken to avoid adverse effects, minimize potential harm, and preserve and enhance wetlands, to the extent possible.	Applicable	These requirements are applicable if treatment units or associated facilities are constructed in wetlands. No such construction is anticipated.
	California Department of Fish and Game Code Section 5650(a), (b), &(f)	Unless authorized and in compliance with waste discharge requirement or a waiver or permit issued, Fish and Game Code Section 5650 makes it unlawful to deposit into, permit to pass into, or place where it can pass into the waters of the State certain specified pollutants (e.g., petroleum products, factory wastes, sawdust, lime, and cocculus indicus - a natural plant toxin that stuns fish), as well as a broad proscription against the deposit of any "material deleterious to fish, plant life, or bird life."	Relevant and Appropriate	No such action is anticipated.
	California Department of Fish and Game Code Section 1908	Section 1908 specifies that no person shall take, possess, or sell any native plant that the Commission determines to be an endangered native plant or rare native plant, except as otherwise noted.	Relevant and Appropriate	No such action is anticipated.
	California Department of Fish and Game Code Section 2080	Section 2080 specifies that no person shall import into this State, or export out of this State, any species that the Commission determines to be an endangered species or a threatened species, except as otherwise noted.	Relevant and Appropriate	No such action is anticipated.

TABLE 7C
Location-specific ARARs
Basewide VOC Groundwater ROD, Former McClellan Air Force Base

Location	Requirement	Description	ARAR Determination	Comments
Creeks	Clean Water Act, 40 CFR Section 231.10	The Clean Water Act prohibits discharge of dredged or fill materials (i.e., bank material that may fall into creeks) into surface water. This requirement is applicable to construction activities that may affect creeks at the Base.	Applicable	Construction affecting creeks (i.e., discharges) was previously completed under the IROD. No additional construction that would impact creeks is anticipated.
Wetlands	Appendix A to Part 330 (33 CFR 330)	The following conditions/practices must be followed: any structure or fill shall be maintained, including maintenance to ensure public safety; erosion and silt controls must be used and maintained during construction, and all fills must be permanently stabilized at the earliest practicable date; heavy equipment working in wetlands must be placed on mats or other measures must be taken to minimize soil disturbances; no activity conducted under a nationwide permit must jeopardize the continued existence of a threatened or endangered species or a species proposed for designation.	Applicable	Wetlands are located at McClellan. Endangered flora and wildlife species and species of concern have been identified onbase and within 25 miles of McClellan. No construction that would impact creeks or wetlands is anticipated.

Note:
TBC = to be considered

enforceability and general applicability, they would be satisfied by the selection by the Air Force of maximum contaminant levels (MCLs) as groundwater cleanup standards. The position of the Air Force regarding the State's failure to demonstrate that the resolutions and policies are enforceable and generally applicable is described in more detail in dispute documents provided by the Air Force.

State Position

The State has identified State Water Resources Control Board Resolutions 68-16 and 92-49 and the "Policy for Investigation and Cleanup of Contaminated Sites" contained in the Central Valley Regional Water Quality Control Board's Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins as proposed Applicable or Relevant and Appropriate Requirements (ARARs) for determining cleanup levels for VOCs in the vadose zone at McClellan AFB. The USAF and State disagree about whether those State requirements are ARARs for this cleanup.

With respect to Resolution 68-16, the State asserts that discharges subject to the Resolution include the continuing migration of in-situ contamination from the vadose zone to groundwater. Under Resolution 68-16 some degradation may be allowed so long as the cleanup action applies best practicable treatment or control to prevent further migration of waste to waters of the State at levels that exceed the water quality objectives or impact beneficial uses. With respect to Resolution 92-49, the State asserts that the Resolution is an applicable requirement for remedial actions of the vadose zone where the waste either discharges to or threatens to discharge to water for the State. In such a case, Resolution 92-49 requires remediation of the vadose zone to the lowest concentration levels of constituents technically and economically feasible, which must at least protect the beneficial uses of groundwater and surface water, but need not be more stringent than is necessary to achieve background levels of the constituents in surface water and groundwater. With respect to the Basin Plan, the Regional Water Board asserts that the Cleanup Policy applies to determining the appropriate cleanup level in the vadose zone that will comply with Resolution 68-16 and Resolution 92-49 and will meet the water quality objectives in the Basin Plan and protect the beneficial uses. The position of the State with respect to those requirements is described in greater detail in the dispute documents provided by the State.

The State agrees that application of the McClellan AFB START/STOP criteria, as proposed, will provide substantive compliance with Resolution 68-16, Resolution 92-49, and the Basin Plan and, therefore, will not object if the Air Force does not identify those requirements as ARARs in the ROD. The response actions are in the best interests of the people of the State. The criteria are intended to result in cleanup to the lowest level that is economically and technically feasible and that will protect the beneficial uses of the waters of the State.

2.12.3 Cost Effectiveness

In the lead agency's judgment, the Selected Remedy is cost effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost effective if its costs are proportional to its overall effectiveness" (NCP Section 300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness," of those alternatives that satisfied the threshold criteria (i.e., were protective of human health and the environment, and ARAR compliant). Overall effectiveness was evaluated by assessing the balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; short-term effectiveness; and implementability). Overall effectiveness was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of the Selected Remedy was determined to be proportional to its costs; hence, this alternative represents a reasonable value for the money to be spent.

The Air Force believes that the Selected Remedy provides a significant protection of human health and the environment, and is cost effective. The Air Force also believes that the Selected Remedy's combination of SVE, groundwater pump and treat, and institutional controls will provide an overall level of protection comparable to the WQO alternatives at a significantly lower cost.

2.12.4 Use of Permanent Solutions and Alternative Treatment to the Maximum Extent Practicable

The Air Force has determined that the Selected Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be used in a practicable manner at the site. The Selected Remedy treats the COCs at the site, achieving significant reductions in VOC concentrations in the vadose zone and groundwater. The Selected Remedy satisfies the criteria for long-term effectiveness by removing VOCs from the vadose zone and groundwater. SVE and extraction and treatment systems will effectively reduce the mobility of and potential for direct contact with contaminants remaining onsite. The Selected Remedy does not present short-term risks different from the other treatment alternatives. There are no special implementability issues that set the Selected Remedy apart from any of the other alternatives evaluated.

2.12.5 Preference for Treatment as a Principal Element

By removing VOCs in the soils using SVE in the source areas and extracting groundwater from the hot spots, the Selected Remedy addresses VOCs at the site through the use of treatment technologies. By using treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

2.12.6 Requirements for Five-Year Reviews

Because this remedy will result in hazardous substances remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory five-year review will be conducted in 2009 and every five years after, until the VOC ROD cleanup levels have been achieved, to ensure that the remedy is, or will be, protective of human health and the environment. This will be the third five-year review; the first five-year review was completed in 1999; the second was completed in 2004.

2.13 Documentation of Significant Changes

In the 7 years that have passed since the completion of the 1999 VOC FS, the Air Force has made significant progress resolving some key issues that affect the remedy for VOC contamination in the vadose zone and groundwater. Alternative dispute resolution and formal dispute resolution resulted in agreement on VOC groundwater cleanup levels for McClellan documented in this ROD. It also resulted in clarifying the process for initiating and terminating SVE systems (the START and STOP processes, respectively).

Additionally, increased national focus on institutional control issues resulted in new EPA guidance, Air Force policies, and a new State regulation. At the time of the 1999 Basewide VOC FS (CH2M HILL, 1999), the Air Force planned for a single VOC ROD that would address VOCs in the groundwater and soils. Thus, the FS evaluated alternatives that would clean up VOCs in groundwater and the vadose zone. Because some of the VOCs in the vadose zone are close enough to the surface to pose a risk for surface exposure (for example, indoor air), the 1999 Basewide VOC FS also evaluated alternatives for shallow soil gas. However, the 1999 Basewide VOC FS did not completely discuss potential land use restrictions. In 2003, the Air Force decided to separate the groundwater remedy from the shallow soil gas remedy, because complicated technical issues concerning shallow soil gas appeared likely to hold up the VOC ROD. To facilitate completing the VOC ROD for the groundwater pathway, the Air Force completed the VOC FS Addendum in July 2004 to more completely evaluate land use restrictions (AFRPA, 2004c).

The Air Force issued a final Proposed Plan in June 2004 for public comment (AFRPA, 2004a). A public meeting was held on July 21, 2004, to explain the Proposed Plan and to solicit comments from the public. Responses to those comments are provided in Section 3. Subsequently, the Air Force began preparing the Base VOC Groundwater ROD. However, before the ROD was finalized, the State and EPA invoked the dispute provisions of Section 12 of the McClellan Interagency Agreement. To resolve the dispute, the Senior Executive Committee directed that a team composed of staff from the Air Force, DTSC, RWQCB, and EPA work to resolve the technical issues. Specifically, the team was directed to develop a final groundwater remedy that is acceptable to the parties of the Interagency Agreement and interested stakeholders. The team used the existing monitoring data from the phased implementation of the IROD remedy to revise the conceptual site model and develop a groundwater fate and transport model. While the technical team was working, the Air Force continued with installation of Phase III of the IROD remedy that was completed in September 2005. Phase III of the IROD was designed so that with its implementation, the extraction and treatment capability at McClellan defined by Alternative 2B is complete.

The new fate and transport model is more sophisticated than the flow model used for the VOC FS. The new model better simulates the movement and degradation of VOCs in groundwater. Once the model was completed and the outputs were verified using existing data, the model was used to revise the time to clean up groundwater under Alternative 2B. The revised time to clean up groundwater (55 years) is significantly less than predicted by the flow model in the VOC FS. This reduction in time to cleanup is the result of the new model incorporating decay (reductions in VOC concentrations from physical and biological processes) and more realistically modeling the transient conditions in groundwater. The revised time to clean up for Alternative 2B was also used to revise the cost estimate for the

alternative as discussed in Section 2.12.2. In July 2006, the technical team informed the Dispute Resolution Committee that the technical issues associated with the 2005 dispute had been resolved.

2.14 Works Cited

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URS. 2006a. *Three-Dimensional Groundwater Flow and Fate and Transport Model.* Technical Memorandum. Final. June.

URS. 2006b. *GWTP Operations and Maintenance (O&M) Manual.* Final. November.

URS. 2006c. *Groundwater Monitoring Plan Update.* Final. November.

SECTION 3

Responsiveness Summary

3.1 Background of Community Involvement

A proposed plan and a public comment period are key parts of the decision-making process because the Air Force uses community input when making cleanup decisions. The Groundwater Volatile Organic Compound (VOC) Proposed Plan for this Record of Decision (ROD) was available for review during a 30-day public comment period from July 5 through August 4, 2004. A public notice announced the start of the public comment period. The plan was available for review at the McClellan Information Repository and on the Air Force Real Property Agency (AFRPA) website. A fact sheet that summarized the information in the Proposed Plan was also sent to the McClellan mailing list. In addition, a public meeting was held on July 21, 2004, to explain the Proposed Plan and to solicit comments from the public. The public was encouraged to review the document and provide comments at the meeting verbally (July 2004), in writing, or via email about the cleanup alternatives presented in the Proposed Plan.

Because the Proposed Plan was issued more than 2 years ago, a fact sheet was issued on the revised Groundwater ROD in November 2006. The fact sheet was mailed to the McClellan mailing list and the Air Force held a public comment period from November 18, 2006 through January 3, 2007. During this time, all related documents were available on the website and in hard copy at the McClellan Administrative Record.

3.2 Summary of Comments Received

The Air Force received comments from 13 members of the public during the public comment period in 2004. Three people commented at the public meeting and 10 provided written comments during the comment period. The primary general concern expressed during the public comment period was about cleanup levels. A few members of the public stated a desire for the Air Force to clean up the groundwater to the State's water quality objectives (WQOs); others simply expressed a desire for the Air Force to remove the contamination it has caused. The Air Force received additional comments from the Sacramento Groundwater Authority during the public comment period in 2006/2007. Specific comments and Air Force responses are provided below.

3.2.1 Comments Received from July 21, 2004 Public Meeting and Air Force Responses

GARY COLLIER: My name is Gary Collier, and I'm opposed to the proposal by the Air Force as it fails to protect human health as would occur if the Air Force complied with the State standards, water quality objectives for this cleanup.

The proposed cleanup action plan relies highly on the theory of containment by monitoring wells. This theory is just that, a theory. Technology now exists and is in use in several communities in

conjunction with the universities to test water for contaminants of interest in surface water on a continuous basis. Test results are available 24 hours, seven days a week to researchers and the general public robotically over an Internet interface. The continuous monitoring creates the opportunity to prove a theory wherein slugs of pollutants may be lurking in the aquifer without being detected. It is of interest that when the Air Force monitored the wells on base for its usage, they began testing quarterly in the 1980s. Unfortunately, municipal wells nearby are not tested nearly as frequently causing concern in the community for the safety of their water supplies.

I urge the Air Force to consider the cost efficiency and additional protections which would be afforded our at-risk community by adding a continuous testing system for municipal systems. There are numerous funding sources available outside the Air Force to assist in providing certainty rather than a mere theory regarding protecting health and containing the plumes. Thank you very much.

Air Force Response: Mr. Collier's comment about his preference that the Air Force clean up to the Water Quality Objective is noted.

The Air Force's strategy for containing groundwater contamination is not through the exclusive use of monitoring wells. While monitoring wells provide useful data such as water quality and elevation, extraction wells are the active tools that will contain plume migration. Containment of groundwater plumes through the use of extraction wells is not merely a theory; it is a proven, effective technology that is recognized by the State and Environmental Protection Agency (EPA). After many years of quarterly monitoring, we have empirical data that prove that groundwater extraction does contain plumes. In addition, the Air Force has developed a groundwater model using proven and accepted programs. The model results are in agreement with the containment demonstrated by empirical data.

The Air Force has much experience in continuous sampling of surface waters. However, that technology does not apply to groundwater monitoring. First, continuous sampling of surface waters is either done as a "grab" or "composite" sample. Grab samples are used for instantaneous measurements by programming the sampler to collect a sample at specified sampling frequencies (for example, every 15 minutes, 30 minutes, or hour). Obviously, collecting a sample even at hourly intervals would be extremely expensive due in part to the vast number of monitoring wells at McClellan. Also, horizontal gradients (indication of how fast water moves horizontally) at McClellan are relatively low. Therefore, more frequent sampling does not render data more accurate or reliable. In addition, hourly (or other "continuous") grab sampling or composite sampling from groundwater wells is not practical because of sample volume, preservation, and storage requirements.

FRANK MILLER: *What is the procedure for when you hit multiple contaminants other than trichloroethene (TCE), and you begin to approach the Federal five-part per billion level, and there are several other contaminants involved, and what procedure will be followed? As the contamination level is receding, and you're approaching the five-part per billion level, and that's for TCE, the Federal minimum level, now what happens when there was – there are – there is a multitude of contaminants, besides TCE, and how will that issue be handled?*

Air Force Response: TCE is the dominant contaminant, so that is the driver for the cleanup level. All other VOC contaminants are tested for as well, and these contaminants are treated along with the TCE. The locations of the plumes are very similar. Also, each contaminant will be cleaned up to its own specific cleanup level.

JEANETTE MUSIL: The comment really is, this project, of course, is important, but please do not neglect other projects predominantly reuse. $5 million, I think, is what I learned along the way for the next couple of years is a lot of money in really difficult times, but please don't neglect reuse because we need it for McClellan Park and for the adjacent communities to prosper.

Second comment, and I'm going back to that – the numbers again on dispute resolution. I understand the numbers are on the books. The Feds have their numbers; the states have their numbers. I can only begin to imagine what went into creating those, and I know that's your law, and I know that's what you must abide by. And I think we really must learn a better way to deal with all that. Two years is a very long time. Sounds like things were delayed a long, long time, and I got to believe that there was a lot of time and money spent, so maybe the next go-around I just offer if we think about what's important to public health and what's worthy of dispute, and if we have to dispute, is there a more effective way to do it.

Third comment, and it's IC's, it's institutional control related, please do not assume that the County will implement these institutional controls or fund them. Our marching orders for the County and everyone in this room obviously is public health, and I offer that the County nor the community caused the contamination, and so I'm pondering why it would be suggested that the County would either fund the cleanup of it or monitor the – the continued existence of it. I don't get that, and when I flip through some of the slides, you know, there's a number there, page, I don't know, 28. There's a number about what the cost will be to Sacramento County. I have no clue how that got there or how they came up with. And what I did learn today, and this is good for me to know, is the signing of the ROD. That has to be – that cannot be signed until we all decide how those institutional controls are implemented and funded, and that will be – that will be our future for sure.

Air Force Response: The Air Force places a high priority on projects that help facilitate reuse and considers reuse and land transfer very important.

The dispute resolution process did take time, and did delay the schedule for this ROD. However, it did not delay any progress toward cleaning up the groundwater because the Air Force continued to implement the Interim ROD. The Interim ROD involved installing a network of groundwater extraction wells, monitoring wells, and a treatment system. This dispute was primarily about the cleanup level that would determine when the cleanup would be considered complete. The dispute resolution process did not delay property transfer schedules.

The institutional controls referred to in the Feasibility Study (FS) Addendum (AFRPA, 2004c) and during the public meeting that the county will be responsible for are primarily the City of Sacramento and County of Sacramento ordinances that are already in place, such as the ordinance prohibiting the installation of new private wells in the prohibition area on the west side of the base. The county will also be responsible for providing public advisories about these ordinances, which they are already doing in large part, in addition to Air Force advisories.

The Air Force has held discussions with the Local Reuse Authority as well as the Restoration Advisory Board about institutional controls, their impact on cleanup decisions and property transfer.

3.2.2 Comments Submitted in Writing to Air Force Real Property Agency during the 2004 Comment Period and Air Force Responses

A. PRICE: If the Air Force put it there, then the Air Force should clean it up, the sooner, the better. Cleanup should continue until all plumes are eliminated or reduced to a trace. A combination of "pump and treat" and Soil Vapor Extraction (SVE) should be used. If plume is well above groundwater use SVE. If it is both above and in groundwater, use both. Our water should be slightly better than drinking water standards to compensate for trace toxic elements that may seep in over time.

Air Force Response: The Selected Remedy is the use of pump and treat and SVE systems. The cleanup level is drinking water standards, and as described in the dispute resolution, the Air Force will then evaluate the feasibility of cleaning to the State WQO.

MANNARD G. GAINES: The reports I have been getting let me know that you are doing a very fine job. I don't have a chance to get to your meetings because they are on the wrong night and time for me, but I still liked [receiving] the report, and to know what you are doing.

Air Force Response: Comment noted. The Air Force typically holds public meetings and RAB meetings on Tuesday, Wednesday or Thursday evenings in an attempt to provide the best opportunity for community members to attend the meetings. The Air Force also provides informational meetings with various community groups to increase public involvement in the environmental cleanup program at McClellan. Additionally, the Air Force provides cleanup information through press releases and public notices, newsletters, fact sheets, and the Administrative Record file, which do not require attending meetings.

MAY ABEL ROLES: Just do the job. Clean up land and water to human use before releasing/selling to the general public. I've lived primarily in this area since 1936 (before McClellan), worked at McClellan a short while in WWII. My husband and oldest son both worked and retired from McClellan AFB, [and] lived [at] this address since Jan 1949, therefore recognize water and possible health problems. The work at McClellan was important / necessary, now clean things up.

Air Force Response: Comment noted and this ROD is an important step towards the goal of cleaning up the groundwater and transferring the base property to the community.

C. MICK AYRES: I'd like to know the current readings for any VOCs and any cleanup procedures contemplated (including debris) specifically for Don Julio Creek and the western fence line running from Vince Ave. south thru Don Julio Creek.

Air Force Response: Effluent from the Groundwater Treatment Plant (GWTP) is not discharged directly to Don Julio Creek; however, effluent discharged to Beaver Pond can enter Don Julio Creek via the spillway at the upper end of the pond or the overflow weir at the downstream end of the pond. Monitoring of GWTP effluent at the Beaver Pond discharge location is conducted quarterly, when discharge is occurring. No VOCs were detected in Beaver Pond during the last most recent quarterly sampling events in June and July 2006.

Sacramento County has responsibility for maintenance of the creeks on McClellan, including Don Julio Creek west of Patrol Road to the McClellan fence line. Removal of debris in this section of Don Julio Creek is conducted as needed to prevent flooding of adjacent properties. For the portion of Don Julio Creek west of the McClellan fence line, maintenance is the responsibility of the City of Sacramento. The City's channel maintenance department may be reached at (916) 433-2269.

The Air Force also posts all major decision documents on its website: www.afrpa.hq.af.mil/mcclellan. Documents are also available in the Administrative Record File/Information Repository at 3411 Olson Street, McClellan, CA. Please contact (916) 643-1250, Extension 239 for hours of operation.

GRACE A. JENNINGS: I'd like to be sure this is a 100 percent sure cleanup of the water. I know from personal knowledge that in San Jose the contaminated soil went down 100 ft further than they thought and I don't think it was ever really cleaned up. I reference FMC property on James Street and Coleman Ave.

Air Force Response: The Air Force is responsible for cleaning up the groundwater, and this ROD has determined the cleanup level. The Air Force is required to conduct long-term monitoring of the soil and groundwater to ensure the effectiveness of the treatment systems. Additionally, to ensure that the remedy is, or will be, protective of human health and the environment, a five-year review will be conducted in 2009 and every five years after, until the cleanup levels have been achieved. This will be the third five-year review; the first five-year review was completed in 1999; the second was completed in 2004.

P. DORIS: As long as you are convinced that SVE methods are effective, then the preferred alternative makes the most sense.

Air Force Response: SVE systems have been proven to be both effective and cost-efficient.

MARTIN ZAVALA: I want to know what is VOCs, can you describe please, and what repercussions will come in the future with those problems. [And] how can we combat any sickness, or disease for contaminated drinking water?

Air Force Response: VOCs are organic compounds containing carbon that evaporate, or volatilize, readily at room temperature. VOCs are used in solvents, degreasers, and metal plating. Exposure to hazardous VOCs may increase the risk of cancer in humans. The groundwater contaminated from VOCs at McClellan is not used for drinking water. The combination of the Air Force's treatment system and City and County ordinances ensure this water is not used for consumption. The Air Force also paid to have the homes on the west side of the base hooked up to municipal water supplies in the mid 1980s as a precaution and protection measure.

INEZ HARMON: As a citizen who lives near McClelland Park, I feel strongly that the clean-up of the underground contaminants should at least meet the California mandate of no more than 2.3 parts per billion. It is the responsibility of the Air Force to return the land to as clean and healthy a state as possible, given the horrible level of contamination. Consider this my vote for meeting the most stringent standards set forth in the proposed plan. We do not own the earth; we have borrowed it from our children.

Air Force Response: The dispute resolution process is summarized in the Proposed Plan and is described in full detail in the Basewide VOC FS Addendum. The resolution states that:

> The Record of Decision will state 5 ppb as the cleanup standard for TCE. The parties agree to proceed with cleanup as proposed by the Air Force until such time as 5 ppb is achieved in each plume, as defined by the BRAC cleanup team. At that point, the Air Force, in collaboration with the State and EPA

Remedial Project Managers, agrees within 60 days to complete an analysis and prepare a report (using agreed upon models) which evaluate the technical and economic feasibility of continuing remediation until plume levels reach 2.3 ppb TCE. After the report is complete, the parties will have another 30 days to reach an agreement. If an agreement cannot be reached, the Air Force may shut off the wells and any party may use the dispute resolution provisions of the Federal Facilities Agreement.

SACRAMENTO GROUNDWATER AUTHORITY (Edward D. Winkler): In response to the proposed plan, we have the following concerns:

1. *Assumptions regarding current and future groundwater levels may not be accurate. For example, it is not clear from your document whether or not the cleanup plans have taken into account the Water Forum Agreement (WFA) executed in 2000 by 40 local utilities, business leaders, environmental and local community representatives. The WFA promotes a regional-scale conjunctive use program. This program involves various partnerships among and between SGA members to facilitate delivery of surface water into the interior of the basin in wet years. Those same purveyors will rely more heavily on the basin in drier years, resulting in a cyclical operation of the basin. The net result, however, will be to stabilize or elevate groundwater levels. The potential for elevated groundwater levels does not appear to be contemplated in your plan.*
2. *Given the purveyors' reliance on the basin for storage and supply to meet the WFA and other commitments, we are concerned that VOCs and other contaminants from McClellan could interfere with or restrict purveyor water operations in the future. We are not aware of any plans to mitigate such impacts.*
3. *We are concerned about the lack of coordination between McClellan, potentially affected purveyors, and SGA. Given the nature of the problems at the site and potential impacts to water purveyors, we suggest that a workgroup be formed to discuss these issues and to explore mutually beneficial solutions.*

Air Force Response: The Air Force is aware that the groundwater level is likely to fluctuate in the future. The conceptual site model has been revised to account for the recent stabilization of the water table. The Air Force will continue its extensive monitoring program to ensure the treatment system remains effective until the groundwater is cleaned up. In addition, the Air Force has developed a fate and transport model that can be used to predict the effectiveness of the treatment system as the water table changes.

The Air Force agrees that communication with the SGA is important. The Air Force has interacted with the SGA to share information in the past. Examples of this include arranging for members of the SGA to tour the cleanup systems at McClellan in 2003 and providing the SGA with information about well locations and water level measurements. There were at least five meetings between Air Force staff and members of the SGA in the two years preceding this comment in addition to other routine communication via telephone and email. Subsequent to receiving this comment, the Air Force invited the SGA to participate in the Joint Technical Team to resolve issues associated with the VOC ROD, and the Air Force appreciated the participation of SGA. The Air Force will continue to be involved with the SGA in discussions concerning the relationship between the groundwater remediation at McClellan and water supply issues in the area.

The Air Force also encourages members of the SGA to attend and participate in quarterly McClellan Restoration Advisory Board meetings, and the Air Force will ensure the SGA is aware of all RAB meetings.

SACRAMENTO SUBURBAN WATER DISTRICT (Robert S. Roscoe): The Sacramento Suburban Water District (SSWD) has reviewed the information provided in the subject document and attended the July 21, 2004 presentation on the Air Force Ground Water VOC Cleanup Proposed Plan. The District applauds the Air Force's commitment to perform clean-up operations for the contamination at and near the former McClellan Air Force Base which impairs groundwater quality. The proposed plan appears to address the immediate situation for cleaning up the different types of contamination that have been introduced on site over the prior half century. Based on the applied efforts of the Air Force to date, cleanup operations have resulted in reducing the size of the contamination plumes and levels of contamination.

SSWD was disappointed to see that residents living around the base were noticeably absent from the July 21, 2004 meeting. It was a loss for both the residents living near the base and for the Air Force to not be able to field many more questions from concerned citizens.

SSWD operates several public water supply wells within the vicinity of the former base. Production wells on the base have not been able to be used due to this contamination. SSWD has assumed operational control and must import water from outside the base to serve customers within the impacted area. During the presentation there were no specific acknowledgements that the Air Force would provide any protection or support to any existing groundwater users in cases of contamination of a supply well. The Air Force is responsible and should address this issue to provide additional protection and support for those existing wells in the area that are not presently affected by the potential contamination.

Presently there is an overdraft of the groundwater basin in the north area of Sacramento County. The plan needs to address how that overdraft is affected by the proposed pumping that will occur at McClellan for remediation. Recharge of the treated groundwater should be included in the plan.

The clean-up target for contaminated groundwater is the maximum contaminant level presently allowed in public water supplies. The public health goal should be the target. On other Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites, clean-up goals are less than Maximum Contaminant Level (MCL). Since it is impossible to sample all affected groundwater, if the clean-up goal is MCL, some areas will be lower and some areas will be higher than MCL. Local pockets of contaminated water unsafe to drink will remain. In addition, the plan needs to address the fact that public health goals and maximum contaminant levels are subject to change. Not only should the target cleanup level be the public health goal for the contaminant of concern, but a sensitivity analysis is required of the potential effects on the recommended option of having those standards lowered in the future.

Earlier clean-up plans assumed the groundwater table would continue to decline. The current assumption is that groundwater levels will remain stable. That assumption is not valid. Local water purveyors, including SSWD, are moving to conjunctive use supplies where groundwater is pumped in dry years and surface water is used (allowing in-lieu recharge of groundwater) in wet years. It is expected that the water table will fluctuate up and down considerably over the next decades (and centuries). Clean-up plans must address the recent change to conjunctive use supplies including water supply plans for active groundwater banking and exchange programs which will further increase vertical changes in groundwater levels. The existence of the groundwater contamination can potentially, severely, limit the use of the aquifer for storage.

Clean-up plans must address plans for provision of alternative water supplies for water purveyors in the vicinity of contaminant plumes. If a well must be removed from service due to contamination from McClellan, an alternate water supply must be available for immediate service.

Air Force Response: The Air Force recognizes that it is responsible in the event that current water supply wells become contaminated as a result of migration of Air Force-caused contamination. The number and location of extraction wells the Air Force is operating is currently stopping migration of contamination.

The Air Force recognizes the overdraft of groundwater in the Sacramento Area, however, due to the site geology at McClellan, it has not been cost effective to recharge the treated water back into the aquifer.

The public health goal is a level that is applicable for drinking water supplies only, not the cleanup of the upper aquifer at McClellan. The Air Force is cleaning up the aquifer to levels that are in accordance with all applicable, relevant, and appropriate standards.

The Air Force currently has about 575 groundwater monitoring wells to sample and monitor the groundwater contamination. More may be needed in the future to minimize the possibility of such contamination pockets, especially as contamination plumes shrink. The dispute resolution process is summarized in the Proposed Plan and is described in full detail in the Basewide VOC FS Addendum. The resolution states that:

> The Record of Decision will state 5 ppb as the cleanup standard for TCE. The parties agree to proceed with cleanup as proposed by the Air Force until such time as 5 ppb is achieved in each plume, as defined by the BRAC cleanup team. At that point, the Air Force, in collaboration with the State and EPA Remedial Project Managers, agrees within 60 days to complete an analysis and prepare a report (using agreed upon models) which evaluate the technical and economic feasibility of continuing remediation until plume levels reach 2.3 ppb TCE. After the report is complete, the parties will have another 30 days to reach an agreement. If an agreement cannot be reached, the Air Force may shut off the wells and any party may use the dispute resolution provisions of the Federal Facilities Agreement.

In response to potential changes in cleanup levels, the Air Force is required to conduct a complete review of the cleanup remedies in place every five years. These Five-Year reviews will take these changes into consideration and evaluate any necessary changes to the remedy in place. The ROD will be amended in response as necessary, in coordination with the State and EPA.

The Air Force is aware that the groundwater level is likely to fluctuate in the future. The conceptual site model has been revised to account for the recent stabilization of the water table. The Air Force will continue its extensive monitoring program to ensure the treatment system remains effective until the groundwater is cleaned up. In addition, the Air Force has developed a fate and transport model that can be used to predict the effectiveness of the treatment system as the water table changes.

3.2.3 Comments Submitted in Writing to Air Force Real Property Agency during the 2006/2007 Comment Period and Air Force Responses

SACRAMENTO GROUNDWATER AUTHORITY (Edward D. Winkler): The Sacramento Groundwater Authority (SGA) appreciates the opportunity to comment on the Groundwater Record of Decision (ROD) Fact Sheet related to the cleanup of Volatile Organic Compounds (VOCs) in groundwater underlying the former McClellan Air Force Base (McClellan). The SGA is a joint powers authority formed in 1998 to manage the groundwater basin underlying Sacramento County north of the American River. SGA members include all 14 organized water purveyors in northern Sacramento County. Groundwater comprises approximately 50 percent of the developed municipal supply for the more than 500,000 residents living within the SGA area, making this one of our most important natural resources in the region. In response to the Groundwater ROD Fact Sheet (Fact Sheet) and associated materials, we have the following comments:

1. *We request an evaluation of the time estimated to cleanup contaminants to a level that would meet State Water Quality Objectives as part of the process for completing a Final Groundwater VOC ROD. It is our understanding that the decision to cleanup to the current proposed maximum contaminant level (MCL) standard comes from a 2001 dispute resolution. Our concern is that the cleanup alternatives evaluated and settled during the 2001 dispute resolution were based on a 1999 feasibility study. That study estimated cleanup to the MCL at approximately 147 years (Alternative 2B). Alternative 3B included cleanup to the more stringent State Water Quality Objectives, which are more protective of human health in this vital regional groundwater basin. The cleanup time for Alternative 3B was then estimated at 249 years and was argued to be infeasible. The November 2006 Fact Sheet now indicates that cleanup to the MCL is expected to be achieved for the most recalcitrant contaminant within 55 years, and many of the other contaminants will be cleaned up well in advance of that. Given that the new modeling results indicate significantly reduced cleanup time to the MCL, an evaluation is also needed of the cleanup time to satisfy State Water Quality Objectives as part of the process for completing a Final Groundwater VOC ROD to determine if that time has also been substantially reduced. We believe that the cleanup goal should be to maximize protection of human health, which is more appropriately reflected in the State Water Quality Objectives.*

2. *We request a description of the process for ongoing monitoring requirements for contaminants as cleanup levels are achieved and how cleanup could be impacted by future changes to water quality standards. Since some contaminants are expected to be cleaned up early in the process and others are expected to take decades, we are concerned that monitoring for some contaminants will be discontinued prematurely. For example, if the first contaminant had an estimated time of cleanup of 10 years, how long would that contaminant continue to be monitored? Assuming then that 20 years after cleanup of the first contaminant occurred, while McClellan is still being remediated for other contaminants, that EPA lowered the MCL for the first contaminant, what would be the obligation of the Air Force to begin a renewed cleanup effort for that contaminant? What would the obligation of the Air Force be to begin remediation after all contaminants achieved the agreed upon water quality standards if the standards were subsequently lowered at a future date (e.g., beyond 55 years under the current proposal)?*

3. *We are concerned about the Federal commitment to fund the cleanup effort in the future. We understand that once the Final Groundwater ROD VOC is in place, operation and maintenance costs will be subject to annual appropriations. Given the attempt of the March 2004 Draft Final VOC ROD submitted by the Air Force to scale back the cleanup effort, we are concerned about future potential funding reductions for cleanup of this vital public water supply. Therefore, this*

effort must continue to receive adequate funding to not only maintain the existing system into the future, but to continue to investigate methods for more efficiently remediating contaminants to the lowest level feasible.

4. *We want to continue to emphasize the need for McClellan to coordinate with potentially affected water purveyors and SGA. We appreciate the recent efforts by the Air Force to increase coordination through our participation in the recent technical working group formed as part of resolution over the dispute of the March 2004 Draft Final VOC ROD. We believe that your process benefited by including the local water interests, and we request that your future cleanup and evaluation processes also include local water interests. As we have indicated to the Air Force through the technical working group, SGA member agencies are planning to expand their conjunctive use operations in the basin to ensure water supply reliability for the region. The Air Force cleanup efforts should be operated such that the conjunctive use operations are not hampered. This will require significant future coordination.*

Air Force Response:

1. You are correct that the 2001 formal dispute resolution established MCLs as the relevant and appropriate cleanup standard for the Final Groundwater VOC ROD. In addition, the 2001 dispute resolution requires that once MCLs are reached the Air Force must evaluate the technical and economic feasibility of continuing to operate to a lower cleanup level. This evaluation must be submitted to the regulatory agencies for review. These requirements are include in the Final Groundwater VOC ROD.

   As specified in the ROD, the point that MCLs are reached is an appropriate time to evaluate if additional cleanup is appropriate. If additional cleanup is deemed to be practicable and appropriate at that time, one of the outcomes will be an estimate of the additional time and cost required to achieve the desired cleanup level.

2. McClellan AFB has a very comprehensive and robust groundwater monitoring program. Groundwater is monitored with multiple data quality objectives including source areas, MCL boundaries and detection level boundaries for the full "suite" of VOCs.

   During the remedial action implementation, the Air Force has the obligation to assure that human health and the environment are being protected. This protectiveness evaluation is done on a real-time, continuous basis. If the MCL for a contaminant were lowered, the Air Force is required to evaluate remedy protectiveness. Once "active" remediation is completed, if hazardous substances, pollutants, or contaminants remain at McClellan above levels that allow for unlimited use and unrestricted exposure, the Air Force is required to review protectiveness no less often than every five years.

3. You are correct; the Air Force environmental program is subject to annual appropriations. Once the Groundwater VOC ROD is signed, the Air Force is obligated to implement the selected remedial action.

4. The Air Force is committed to continue to work with the potentially affected water purveyors and SGA in a cooperative and open manner.

3.3 Technical and Legal Issues

This section addresses any outstanding technical or legal issues related to the remedy selection and implementation, of which there is only one. The following is the State's Position on the 2001 Dispute Resolution provided by the RWQCB:

> In the event that a COC, other than TCE, is the last constituent to reach its chemical specific MCL in a particular plume (as defined by the BRAC cleanup team), the State reserves its right to dispute the determination of when to stop groundwater extraction based on the State's interpretation of substantive compliance with Resolution 92-49 and the Basin Plan's Water Quality Objectives including the Narrative Toxicity Objective, for protection of human health and groundwater quality. This determination and potential dispute may occur when extraction wells are proposed for shut down.

Attachments

ATTACHMENT 1

Dispute-Related Documents

ATTACHMENT 1A

Resolution of Formal Dispute on the Proposed Plan for the VOC Operable Unit, McClellan Air Force Base, EPA Region 9 Letter, dated 5 December 2001

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

December 5, 2001

Gary Carlton
Executive Officer
Central Valley Regional Water Quality Control Board
3443 Routier Road, Suite A
Sacramento, CA 95827

Terry A. Yonkers
Acting Deputy Assistant Secretary of the Air Force
for Environment, Safety and Occupational Health
1600 Air Force Pentagon, 5C866
Washington, D.C. 20330-1660

Subject: Resolution of Formal Dispute on the Proposed Plan for the VOC Operable Unit, McClellan Air Force Base

Dear Mr. Carlton and Mr. Yonkers:

Attached for your signature is a written decision of the Senior Executive Committee (SEC) resolving the formal dispute on the McClellan Air Force Base Proposed Plan for the VOC Operable Unit. The decision has been prepared in accordance with section 12.6 of the Amended Federal Facility Agreement for McClellan Air Force Base dated May 5, 1990. Please sign the decision where indicated and return it to me for distribution.

Thank you both for your personal efforts to resolve this matter.

Sincerely,

Keith Takata

Keith Takata
Director,
Superfund Division

cc: Antonia Vorster
Central Valley Regional Water Quality Control Board

Paul Brunner
AFBCA

Decision of the Senior Executive Committee (SEC) Resolving the Formal Dispute over the Proposed Plan for the VOC Operable Unit, McClellan Air Force Base

In the matter of the formal dispute before the Senior Executive Committee (SEC) regarding the McClellan Air Force Base (McAFB) Proposed Plan for the VOC Operable Unit, the SEC issues this written decision in accordance with Section 12.6 of the Amended Federal Facility Agreement for McClellan Air Force Base dated May 5, 1990. This decision incorporates the agreement reached by the Air Force, the State of California, and the Environmental Protection Agency in settlement of the dispute brought by the State of California regarding the Air Force's Proposed Plan dated March 2000 for cleanup of volatile organic compounds in soil and groundwater at McClellan Air Force Base.

The issues in dispute are: (1) Are State Board Resolution 92-49 and the Central Valley Water Board's Basin Plan (in whole or in part) considered to be Applicable or Relevant and Appropriate Requirements (ARARs) in setting cleanup levels in groundwater? (2) If State Board Resolution 92-49 and the Basin Plan are considered to be Applicable or Relevant and Appropriate Requirements, how should they be interpreted to set groundwater cleanup levels? (3) What are appropriate remedial action objectives for cleanup of groundwater? The "Dispute Resolution Committee Consensus Statement on McClellan Air Force Base VOC Proposed Plan Dispute" contains a more detailed summary of the issues in dispute. The individual position papers submitted to the SEC by the parties contain the facts and arguments that were presented to the SEC concerning the issues in dispute.

The SEC has reached unanimous agreement as follows:

(1) The parties recognize Section III.G of State Board Resolution 92-49 and the narrative toxicity objective for groundwater in Chapter III of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins as ARARs for the McClellan VOC Record of Decision.

(2) Under the currently available specific facts at McClellan, the Air Force and EPA believe that both ARARs result in a cleanup standard of 5 parts per billion (ppb) TCE, based primarily on economic feasibility. The State believes that application of both ARARs results in a cleanup standard of 2.3 ppb TCE. The Record of Decision will state 5 parts per billion as the cleanup standard for TCE. The parties agree to proceed with the cleanup as proposed by the Air Force until such time as 5 ppb is achieved in each plume, as defined by the BRAC cleanup team. At that point, the Air Force, in collaboration with the State and EPA Remedial Project Managers, agrees within 60 days to complete an analysis and prepare a report (using agreed upon models) which evaluates the technical and economic feasibility of continuing remediation until plume levels reach 2.3 ppb TCE. After the report is complete, the parties will have another 30 days to reach an agreement. If an agreement cannot be reached, the Air Force may shut off the wells and any party may use the dispute resolution provisions of the Federal Facility Agreement.

(3) The parties agree to not include either of the disputed remedial action objectives in the VOC Record of Decision.

This decision may be executed and delivered in any number of counterparts, each of which when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

12-27-01
Date

Gary Carlton
Executive Officer
Central Valley Regional Water Quality Control Board

10 Dec. '01
Date

Terry A. Yonkers
~~Acting~~ Deputy Assistant Secretary of the Air Force
for Environment, Safety and Occupational Health

12-5-01
Date

Keith Takata
Director, Superfund Division
Region 9
United States Environmental Protection Agency

ATTACHMENT 1B

Resolution of the McClellan Air Force Base (AFB) VOC Groundwater Record of Decision (ROD) Dispute, EPA Region 9 Letter, dated 8 September 2005

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

OFFICE OF THE
REGIONAL ADMINISTRATOR

September 8, 2005

Colonel Richard Ashworth, USAF
Acting Deputy Assistant Secretary
Environment, Safety and Occupational Health
Department of the Air Force (SAF/IE)
1665 Air Force Pentagon
Washington DC 20330-1665

Mr. Leonard Robinson
Acting Director
California Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826

Subject: Resolution of the McClellan Air Force Base (AFB) VOC Groundwater Record of Decision (ROD) dispute

Dear Colonel Ashworth and Mr. Robinson:

The purpose of this letter is to document the agreements reached during the McClellan Groundwater VOC ROD dispute Senior Executive Committee (SEC) meeting. The meeting was held on August 24, 2005 via conference call. I represented the Environmental Protection Agency (EPA), Colonel Ashworth represented the Air Force, and Mr. Robinson represented the Department of Toxic Substances Control (DTSC). Mr. Pinkos was also present for the California Regional Water Quality Control Board, Central Valley Region. The issue presented to the SEC for resolution was whether the Draft Final McClellan AFB VOC Groundwater ROD, dated March 2005, should be approved by EPA. The meeting produced a mutual agreement of the SEC members regarding the following three items:

1. The Air Force will defer the Draft Final VOC Groundwater ROD (March 2005) for some period of time and will document this agreement in a letter to be submitted to the EPA and State.

2. The technical team members from the Air Force, EPA and State of California (both the DTSC and RWQCB) will conduct a technical analysis of

the site data to develop a revised site conceptual model. The technical team should initiate discussions on the process and data needs for a CERCLA Technical Impracticability (TI) Waiver and a State containment zone or de-designation decision. Through these discussions, we anticipate that a consensus can be reached on the timeline for (a) developing additional data to support a TI waiver application and (2) the follow-on final ROD for groundwater at the site.

3. All parties will assist in preparing a joint press release that documents the resolution of the dispute.

In addition to these three explicit agreements, there were discussions and acknowledgments during the SEC conference call that we believe should be documented in this letter to guide development of a future final groundwater ROD. The Air Force agreed that the drinking water beneath McClellan AFB is a designated drinking water aquifer and that Maximum Contaminant Levels (MCLs) are the relevant and appropriate cleanup standards for the groundwater cleanup at McClellan. In addition, all parties acknowledged that the 2001 SEC dispute resolution agreement is still applicable to any final groundwater cleanup decisions. Lastly, the Air Force affirmed its commitment to fully implement the Interim Groundwater ROD, signed in 1993, with the installation and operation of the Phase III groundwater wells.

With the mutual agreements reached above, the formal dispute of the Draft Final McClellan AFB VOC Groundwater ROD (March 2005) is considered resolved at the SEC level for now. During the technical review process discussed above, any issues or disagreements should be considered by the DRC. Further, we believe that final VOC groundwater remedy decision is suspended until such time that the Air Force elects to resubmit a final groundwater ROD. The FFA review periods and dispute process would apply to any new documents submitted in support of a final remedy.

We appreciate the cooperation shown by all parties in resolving this dispute and believe this collaborative outcome will prove to be extremely beneficial for selection of a final groundwater remedy that is acceptable to all the FFA parties and interested stakeholders.

If you have any questions regarding this letter or would like to discuss this further, please contact me or Mr. Keith Takata at (415) 947-8709.

Sincerely,

Wayne Nastri
Regional Administrator

cc: Mr Rich Moss, DTSC
Mr. Tony Landis, DTSC
Ms. Ton Voraster, RWQCB
Mr. John Russell, RWQCB
Mr. Gerald Johnson, Air Force
Ms. Clare Mendelson, Air Force
Ms. Carolyn White, Air Force

ATTACHMENT 1C

Joint Technical Team (JTT) Remedy Consensus for the McClellan Air Force Base (AFB) Volatile Organic Compound (VOC) Record of Decision (ROD) Dispute Letter, dated 25 July 2006

DEPARTMENT OF THE AIR FORCE
AIR FORCE REAL PROPERTY AGENCY

25 July 2006

MEMORANDUM FOR SEE DISTRIBUTION

FROM: AFRPA/COO Western Region Execution Center
3411 Olson Street
McClellan CA 95652-1003

SUBJECT: Joint Technical Team (JTT) Remedy Consensus for the McClellan Air Force Base (AFB) Volatile Organic Compounds (VOC) Record of Decision (ROD) Dispute

1. On 24 August 2005, a Senior Executive Committee (SEC) meeting was held as part of the formal dispute regarding the groundwater VOC ROD for McClellan AFB, California. The SEC decided to defer the execution of the ROD, establish a JTT composed of the appropriate technical representatives from the regulatory agencies with the goal to develop "...a final groundwater remedy that is acceptable to all the FFA parties and interested stakeholders", and delegated the technical resolution to the Dispute Resolution Committee (DRC) [see attachment 1, EPA Region IX Ltr, 8 Sep 05].

2. Starting on 26 October 2005, the JTT held a series of meetings working toward their goal. The primary technical requirement for reaching a mutually agreeable proposed remedy was the development of a revised groundwater conceptual site model and corresponding contamination fate and transport analytical model. Development of these models allowed the JTT to evaluate the technical feasibility and cost effectiveness of McClellan's existing Interim ROD (IROD) remedial action. The IROD remedial action was fully implemented by the installation and operation of Phase III groundwater extraction in September 2005. The IROD remedy consists of the following major components:

- 103 groundwater extraction wells
- 575 groundwater monitoring wells
- 2,000 gallons per minute groundwater treatment facility

3. As of their June 2006 meeting, the JTT has completed its stated goal and reached agreement of the following key items:

- Completion and agreement on the groundwater conceptual site model
- Completion and agreement of the groundwater contamination fate and transport analytical model
- Agreement that a new groundwater focused Feasibility Study is not required
- Remedial Action recommendation

The fate and transport analytical model used the existing IROD remedy and estimated the time to reach a Maximum Contaminant Level (MCL) cleanup. The final modeling results predict 55 years to cleanup groundwater to MCL vs. 500 plus years previously estimated. In addition, the modeled groundwater plume, and corresponding remedial system, significantly shrinks within the first 10 years (estimated at over 50% area/volume reduction). The final fate and transport analytical model has good calibration with measured contamination levels over the past 5-year period, and the JTT has confidence in its future prediction. Finally, since the existing IROD remedy was used in the modeling, no capital construction costs are anticipated. See attachments 2 and 3 for fate and transport cleanup time series figures and estimated operation and maintenance costs, respectively.

4. The JTT recommends the following:

- IROD remedial action as the proposed VOC ROD remedy
- MCLs are the relevant and appropriate cleanup level
- The 2001 and 2005 dispute resolutions are applicable to the VOC ROD remedy
- Soil Vapor Extraction (SVE) removal actions be incorporated into the VOC ROD remedy
- SVE START/STOP process be incorporated into the VOC ROD remedy

The Air Force's DRC member, Mr. Gerald Johnson, concurs on the JTT's recommendations. We request that the regulatory agencies DRC members concur. AFRPA will proceed with the drafting and submission of a draft VOC ROD once concurrence is received. We greatly appreciate the cooperation shown by all parties during the resolution of this dispute.

5. If you have any questions regarding this letter or would like to discuss the JTT recommendations further, please contact Mr. Philip Mook at (916) 643-0830 ext 209.

Phil H Mook

FOR DEXTER J. COCHNAUER
Senior Representative

Attachment:
1. EPA Region IX Letter, 8 September 2005
2. Fate and Transport Time Series Figures
3. Estimated Operation and Maintenance Costs

DISTRIBUTION:

To: McClellan VOC ROD DRC Members
Mr. Gerald Johnson, AFRPA
Mr. Keith Takata, EPA Region IX
Ms. Dorothy Rice, DTSC

cc:

Ms. Kathryn Halvorson, AFRPA
Ms. Kathleen Johnson, EPA Region IX
Ms. Sheryl Lauth, EPA Region IX
Mr. Rick Moss, DTSC
Mr. Tony Landis, DTSC
Ms. Ton Voraster, RWQCB
Mr. John Russell, RWQCB

ATTACHMENT 1D

Dispute on McClellan Air Force Base VOC Proposed Plan, Level 3 Consensus Statement to Resolve Issues No. 4 and 5, dated 8 March 2001

Dispute on McClellan Air Force Base Volatile Organic Compound Proposed Plan Level 3 Consensus Statement to Resolve Issues No. 4 and 5

March 2001

DISPUTE ON MCCLELLAN AIR FORCE BASE VOLATILE ORGANIC COMPOUND PROPOSED PLAN

LEVEL 3 CONSENSUS STATEMENT TO RESOLVE ISSUES NO. 4 AND 5

On April 24, 2000 , the Department of Toxic Substances Control (DTSC), the lead agency for the State, invoked formal dispute resolution on behalf of the Central Valley Regional Water Quality Control Board (Regional Board), on the Proposed Plan for cleanup of volatile organic contaminants (VOCs) from the groundwater and vadose zone at McClellan AFB. On May 19, 2000, the Dispute Resolution Committee (DRC) postponed the start of the formal dispute resolution period to allow the parties to use the Alternate Dispute Resolution (ADR) process to attempt to resolve the dispute. As part of the ADR process, Level 1 and Level 2 personnel (the Remedial Project Managers and their respective supervisors from each of the agencies) formulated issue statements clarifying the issues of dispute. The Level 2 Joint Issues Statement described 5 issues of the dispute. Issues 1 through 3 were primarily related to groundwater cleanup, while Issues 4 and 5 were related to soil cleanup.

Level 3 unanimously agrees to the following resolution of Issues 4 and 5 of the Level 2 Joint Issue Statement as described below.

ISSUE 4

Issue 4 was described in the Level 2 Joint Issue Statement as:
"Are specific State requirements, including State Board Resolution 92-49, the Basin Plan, and Water Code Section 13304 ARARs in setting cleanup levels in soil for VOCs? If these State requirements are determined to not be Applicable, are there portions of these requirements that are Relevant and Appropriate?"

Level 3 agrees to resolve this issue through the use of "agree to disagree" language on the ARAR status of State requirements in the VOC Record of Decision. Attachment "A" to this consensus statement includes the "agree to disagree" language that will be used in the ROD. Each party agrees to provide sections of the ROD language.

ISSUE 5

Issue 5 was described in the Level 2 Joint Issue Statement as:
"How are State Board Resolution 92-49, Basin Plan and Water Code Section 13304, or those portions of these requirements determined to be ARARs, interpreted to develop soil cleanup levels."

Level 3 agrees to resolve Issue 5 through the use of various agreements resulting from an informal dispute at Castle AFB on the same issue. These agreements include the following concepts that will be incorporated into any proposed plans and/or decision documents issued by the Air Force in connection with the VOC Record of Decision:

- The cleanup process for VOCs in the vadose zone will result in levels that are economically and technically achievable as determined by the McClellan START/STOP processes. No numerical limits will be used, beyond screening levels. This consensus statement does not establish cleanup standards for the vadose zone.

- Use of the McClellan START and STOP processes to determine when to turn-on and when to shut-off SVE systems, respectively. The McClellan RPMs (Level 1) have revised the Castle START and STOP processes to adapt them to the specific geologic, programmatic, and contaminant distribution aspects of McClellan AFB. The McClellan START and STOP processes are included with this consensus statement in Attachment "B".

- No mention of an arbitrarily-defined mixing zone as an end point or a point of compliance in the ROD.

- Use of best available site characterization data to support the START and STOP analyses.

- The McClellan RPMs have drafted START/STOP processes for three different contaminant distribution scenarios that are likely to occur at McClellan. For these scenarios, the Regional Board acknowledges that at sites subject to these SVE START and STOP criteria, some degradation of the groundwater may occur. The process for the application of the criteria is intended to result in reasonable protection of the beneficial uses of waters of the State. The State's portion of Attachment "A" contains an explanation to be documented in the *Final McClellan Basewide VOC ROD* as to why this potential degradation is acceptable.

This consensus statement has been agreed to by the following Level 3 members of the respective agencies involved:

Anthony Landis — Dated 3-29-01
Anthony Landis
Department of Toxic Substances Control
State of California

Antonia K. J. Vorster — Dated 3/28/01
Antonia K. J. Vorster
Regional Water Quality Control Board
State of California

Dated 3/26/01
Thomas B. Kempster
Air Force Base Conversion Agency
United States Air Force

Daniel A. Meer — Dated 3/30/01
Daniel A. Meer
Federal Facilities Cleanup Branch
United States Environmental Protection Agency

Attachment "A"
"Agree to Disagree" ROD Language

Air Force Position

It is the position of the Air Force that California State Water Resources Control Board Resolutions 68-18 and 92-49 and Basin Plan policies do not meet the National Contingency Plan (NCP) criteria for potential applicable or relevant and appropriate requirements (ARARs) and thus are not ARARs for establishing groundwater cleanup standards for McClellan AFB. The State has not demonstrated that these resolutions and policies, as defined by the State in the context of this cleanup, meet the NCP criteria of enforceability and general applicability. In the alternative, if some or all of the resolutions and policies were redefined by the State to meet the NCP criteria of enforceability and general applicability, they would be satisfied by the selection by the Air Force of maximum contaminant levels (MCLs) as groundwater cleanup standards. The position of the Air Force regarding the State's failure to demonstrate that the resolutions and policies are enforceable and of generally applicable is described in more detail in dispute documents provided by the Air Force.

State Position

The State has identified State Water Resources Control Board Resolutions 68-16 and 92-49 and the "Policy for Investigation and Cleanup of Contaminated Sites" contained in the Central Valley Regional Water Quality Control Board's Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins as proposed Applicable or Relevant and Appropriate Requirements (ARARs) for determining cleanup levels for VOCs in the vadose zone at McClellan AFB. The USAF and State disagree about whether those state requirements are ARARs for this cleanup.

With respect to Resolution 68-16, the State asserts that discharges subject to the Resolution include the continuing migration of in-situ contamination from the vadose zone to groundwater. Under Resolution 68-16 some degradation may be allowed so long as the cleanup action applies best practicable treatment or control to prevent further migration of waste to waters of the state at levels that exceed the water quality objectives or impact beneficial uses. With respect to Resolution 92-49, the State asserts that the Resolution is an applicable requirement for remedial actions of the vadose zone where the waste either discharges to or threatens to discharge to waters of the State. In such a case, Resolution 92-49 requires remediation of the vadose zone to the lowest concentration levels of constituents technically and economically feasible, which must at least protect the beneficial uses of groundwater and surface water, but need not be more stringent than is necessary to achieve background levels of the constituents in surface

water and groundwater. With respect to the Basin Plan, the Regional Water Board asserts that the Cleanup Policy applies to determining the appropriate cleanup level in the vadose zone that will comply with Resolution 68-16 and Resolution 92-49 and will meet the water quality objectives in the Basin Plan and protect the beneficial uses. The position of the State with respect to those requirements is described in greater detail in the dispute documents provided by the State.

The State agrees that application of the McClellan AFB START/STOP criteria, as proposed, will provide substantive compliance with Resolution 68-16, Resolution 92-49, and the Basin Plan and, therefore, will not object if the Air Force does not identify those requirements as ARARs in the ROD. The response actions are in the best interests of the people of the State. The criteria are intended to result in cleanup to the lowest level that is economically and technically feasible and that will protect the beneficial uses of the waters of the state.

ATTACHMENT 2

Level 3 Consensus Statements for SVE Turn-On (START) Criteria and Turn-Off (STOP) Criteria

Attachment "B"
McClellan START and STOP Papers

Included in this attachment are the START and STOP papers that detail how to conduct the START and STOP analyses for three different contaminant distribution scenarios reasonably expected to occur at McClellan Air Force Base. These three contaminant distribution scenarios are:

1. VOC contamination in the vadose zone over water contaminated by the same contaminant(s) of concern.
2. VOC contamination in the vadose zone over clean groundwater.
3. VOC contamination in the vadose zone over groundwater contaminated by different VOCs.

A separate START and STOP paper has been prepared, and agreed to, by the McClellan RPMs for each of these scenarios.

McClellan AFB

SVE TURN-ON (START) CRITERIA
Criteria for Case #1

VOC Contamination in the Vadose Zone Over Groundwater Contaminated with the Same VOC COCs

Introduction

There are a number of factors that can influence the decision to install and operate soil vapor extraction (SVE) at a site where contaminant levels exceed human health or water quality screening threshold criteria. The McClellan AFB SVE start/stop criteria focuses on the analysis of soil vapor extraction (SVE) systems for the remediation of volatile organic compound (VOC) contamination in the vadose zone as it relates to groundwater cleanup and protection. For the protection of groundwater quality the issue becomes: is it technically and economically feasible to install and operate an SVE system to remediate the site?

In addition to the impact on groundwater, under CERCLA there are a number of factors that must be evaluated to arrive at the decision to install and operate an SVE system. These factors are brought out when the feasibility study and the conceptual site model are developed for the site. To ensure that all the factors are considered in the decision to initiate, continue or stop an SVE system, the conceptual site model should be included as an integral tool to be used in the decision-making process.

A typical potential route of exposure, that is present when the vadose zone is contaminated with VOCs, is direct inhalation and contact by humans and biota at or near the ground surface. A site-specific analysis should be conducted to determine whether SVE system operation or other remedial action should be taken or continued to protect receptors from this type of exposure.

Any VOCs remaining in the vadose zone after a decision is made to stop or not start an SVE system must be managed to the degree necessary in relation to its significance. Where the cleanup does not meet unrestricted reuse cleanup standards, management measures, such as institutional controls should be evaluated and implemented if necessary.

In addition to the methods and criteria for analysis presented in these Start/Stop procedures, a separate analysis that addresses other routes of exposure identified in the conceptual site model needs to be conducted and considered in making the decision to begin or continue SVE.

For protection of groundwater quality at McClellan, there are three cases to be considered:

Case #1 - Volatile Organic Compounds (VOC) contamination in the vadose zone over groundwater contaminated with the same VOC contaminant(s) of concern (COCs).
Case #2 - VOC contamination in the vadose zone over clean groundwater.

Case #3 – Some or all VOC contamination in the vadose zone over groundwater contaminated with different COCs.

The SVE turn-on criteria presented below are for Case #1 to determine if SVE should be implemented. For SVE turn-on criteria for the other cases, see documents:

SVE TURN-ON (START) CRITERIA – Criteria for Case #2; and
SVE TURN-ON (START) CRITERIA – Criteria for Case #3

The *McClellan Basewide Feasibility Study Report* (December 1999, FS) identified SVE as the preferred remedial technology for these sites. However the FS used a conservative screening analysis for the remedy selection that did not fully evaluate the practicality of SVE implementation on a site-by-site basis. The criteria below were developed to determine the technical and economical feasibility of SVE for Case #1. The criteria below will be used to determine whether SVE should be implemented for Case #1 at a particular site. This evaluation will be called a "START" and will be a primary document under the Federal Facilities Agreement (FFA).

This analysis applies to sites at McClellan AFB that meet the conditions for Case #1 that are addressed in the *Final McClellan Basewide VOC Record of Decision* (VOC ROD).

The START should be conducted after all the parties agree that:

- The site has been adequately characterized;
- The risk assessment indicates that site contaminants pose a potential threat to either human health and/or the environment, including water quality.
- The FS indicated that SVE is the remedy most suited to remediate the site.

The decision to install and operate an SVE system will depend upon the analysis of the three criteria listed below. It is always technically possible to remove mass, but installing and operating an SVE system requires evaluating the tradeoff between certain monetary expenditure and uncertain environmental benefit. If the contaminant mass in the vadose zone is predicted to not reach the groundwater, remediation will not be warranted.

If the contaminant concentration in the leachate entering the aquifer from the vadose zone is below the aquifer cleanup level selected in the VOC ROD, the aquifer will not be unacceptably degraded further, and remediation will not be warranted. Even if the leachate concentration is above the aquifer cleanup levels selected in the VOC ROD, remediation may or may not be warranted. Several lines of evidence must be used to make this professional judgment since measuring actual leachate concentrations may be technically impractical and predicting leachate concentrations via modeling might be inaccurate.

Decision Criteria

The decision to install and operate SVE will be based on scientific, economic, and engineering judgment using the following criteria in sequence. The Air Force and the regulatory agencies acknowledge that there is uncertainty inherent in all of the elements used in the START, and that consensus is necessary to determine the levels of uncertainty that are acceptable in each of the elements.

I. Will the contaminant mass in the vadose zone reach the groundwater, based on either a screening level or site-specific evaluation?

To answer this question, START elements "A" through "G" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes" or "unknown", then proceed to criterion II.

II. Will the contaminant mass in the vadose zone cause the contaminant concentrations in the leachate to exceed the aquifer cleanup level?

To answer this question, START elements "A" through "H" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes", or "unknown", then proceed to criterion III which requires a complete START.

III. Based on an evaluation of all of the elements, is it appropriate to install and operate an SVE system at the site?

To answer this question, all START elements must be addressed.

- If the answer is "yes", then proceed with SVE system installation and operation.
- If the answer is "no" proceed with site closure negotiations.

Elements of the START

The following elements should be applied to evaluate the criteria listed above.

A. Are there any time- or land use-critical re-use issues with the site, and if so, what are they? These types of issues may preclude the need for further analysis, if SVE is required to address these concerns.

B. What is the estimated contaminant mass and areal and vertical extent of the vadose zone contaminant plume? Include contaminant isoconcentration maps and plume cross-sections to illustrate the contaminant concentrations and distribution in the subsurface.

C. Do the data indicate contaminant migration towards the groundwater? Qualitative answers to this question may be either "yes", "no" or "unable to make a determination". Evidence for migration towards groundwater may include such lines of evidence as: 1) increasing contaminant concentrations in onsite monitoring wells; 2) soil gas profiles from nested wells to estimate the contaminant's propensity for migration; and 3) time-series profiles of soil gas concentrations in nested wells.

D. What is the lithology of areas that demonstrate significant soil gas concentrations of contaminants? Use site-specific information, and include as much information as possible, such as porosity, moisture content and carbon content of soil, etc.

E. What are the actual site-specific infiltration and percolation rates? If site-specific data are not available, what are the predicted rates?

F. Are there sufficient historical groundwater monitoring data for wells at or adjacent to the site to determine whether the vadose zone plume has or has not impacted the groundwater? (This determination may not be possible due to active groundwater extraction in the area.)

G. Are there any other site-specific factors that should be considered in the evaluation such as site history and physical characteristics (e.g. organic carbon, biodegradation)? Factors to consider for this element include: 1) the nature of the release (for example: one-time spill or continued release over time?; how long ago the release occurred or ceased?; was the release to surface soil, or through a conduit to the subsurface such as a French drain, dry well, or leaking sewer line?, etc.); and 2) any site-specific physical characteristics that may enhance or retard the contaminant's subsurface migration (such as unusual presence or absence of low permeability layers, high carbon content of soil, etc.).

H. What is the actual or predicted concentration and mass flux rate of leachate leaving the vadose zone? What is the predicted concentration trend of leachate over time based on modeling?

I. Qualitatively, what is the estimated SVE effectiveness of a system, based on known information and experience from similar sites?

J. How much money, if any, has been spent to date on the site's remediation?

K. What is the estimated cost to install an SVE system?

L. What are the locations and capture zones of operating groundwater extraction wells relative to the vadose zone contaminant plume? Will the existing groundwater wells effectively (i.e., technically and economically) capture the contaminants from the site? If not, what are the additional costs to add groundwater extraction wells?

M. What is the cost of vadose zone remediation compared to the incremental cost for additional groundwater remediation due to impacts from the site provided that the underlying contamination has not reached aquifer cleanup levels? In other words, will the residual mass in the vadose zone significantly prolong the time and increase the cost to attain the aquifer cleanup level?

To implement element "M" the following costs need to be calculated:

- The cost (GW_1) to reach the aquifer cleanup level *with* the additional impact from the site (assume SVE will not be implemented);
- The cost (GW_2) to reach the aquifer cleanup level *with* the additional impact from the site after a period of SVE operation; and
- The cost (SVE_1) of SVE installation and operation.

These costs can be calculated following the steps outlined below:

1. Using the measured soil gas concentrations at the site, calculate the mass of the contaminant in the vadose zone (same as element "B").

2. Estimate the site's potential impact to groundwater using appropriate vadose zone and groundwater fate and transport models.

3. Estimate the time to reach the groundwater aquifer cleanup level using the modeling results obtained in step 2 above.

4. Estimate the monthly cost to continue operation of the groundwater extraction system in the area impacted by the site.

5. Calculate the cost to reach the aquifer cleanup level *with* the additional impact from the site (GW_1), because SVE will not be installed and operated. (GW_1 = (step 3 x step 4) plus element L).

6. Estimate the monthly cost to operate the SVE system based on historical costs from similar sites (including all costs relating to operation and shutdown).

7. Estimate the cost to install an SVE system and operate for an estimated length of time that is based on site-specific conditions, such as 24 months. (SVE_1 = length of time x step 6 plus cost to install SVE, i.e., element K)

8. Estimate what the predicted residual soil gas concentrations would be if the SVE system were operated for the estimated length of time.

9. Estimate the impact to groundwater from the site based on the results of step 8. This estimation can be conducted similarly to step 2 above.

10. Estimate the predicted time required for groundwater extraction system to reach aquifer cleanup level *with* the additional impact from the site assuming operation of the SVE system for the period of time estimated in step 7.

11. Calculate the cost to reach the aquifer cleanup level (GW_2) *with* the additional impact from the site assuming operation of the SVE system for the estimated period of time. This cost is calculated by multiplying the results of step 10 by the results of step 4. (GW_2= step 10 x step 4)

12. Compare the costs to reach the aquifer cleanup level *with* the additional impact from the site to the costs of installing and operating an SVE system plus the cost to reach the aquifer cleanup level *with* the additional impact from the site after operation of the SVE system for an estimated period of time. Mathematically this can be expressed as:

$$\text{Is } GW_1 > SVE_1 + GW_2 ?$$

If GW_1 is greater than (SVE_1 + GW_2), installation and operation of an SVE system should be strongly considered.

Implementation

The Air Force, the USEPA, and the State (DTSC and the RWQCB) will jointly decide, based on the START evaluation, whether the SVE system should or should not be installed at the site. The START should be implemented in a phased approach, with the less complex criteria (criteria I and II described above) being evaluated first. Evaluation of these two criteria may indicate that the SVE system is not necessary, without having to perform a complete START (criterion III).

There are several potential outcomes of the START evaluation. Ideally, the START would indicate unequivocally that either the SVE system would not be necessary, and all parties agree that the site could be closed, or that SVE is warranted at the site and should be installed and operated. Another potential outcome is that the START would indicate that the SVE system is not economically or technically justified, but that the site may not yet be suitable for closure, based on remaining threats to the environment or water quality. In this case, additional discussion between the parties is necessary to determine what course of action is warranted, such as alternate remedial measures or long-term monitoring.

Due to the reliance of the START on professional judgment, another outcome of the START is that the parties may not agree on whether the SVE system should be installed or not. If the parties cannot reach a joint resolution, any party may invoke dispute resolution.

US EPA: RPM

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AFBCA: RPM

Philip H. Mook, Jr.

CA DTSC: RPM

Mark Malinowski

CVRWQCB: RPM

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McClellan AFB

SVE TURN-OFF (STOP) CRITERIA
Criteria for Case #1

VOC Contamination in the Vadose Zone Over Groundwater Contaminated with the Same VOC COCs

Introduction

There are a number of factors that can influence the decision to continue to operate soil vapor extraction (SVE) at a site where contaminant levels exceed human health or water quality screening threshold criteria. The McClellan AFB SVE start/stop criteria focuses on the analysis of soil vapor extraction (SVE) systems for the remediation of volatile organic compound (VOC) contamination in the vadose zone as it relates to groundwater cleanup and protection. For the protection of groundwater quality the issue becomes: is it technically and economically feasible to continue to operate an SVE system to remediate the site?

In addition to the impact on groundwater, under CERCLA there are a number of factors that must be evaluated to arrive at the decision to install and operate an SVE system. These factors are brought out when the feasibility study and the conceptual site model are developed for the site. To ensure that all the factors are considered in the decision to initiate, continue or stop an SVE system, the conceptual site model should be included as an integral tool to be used in the decision-making process.

A typical potential route of exposure, that is present when the vadose zone is contaminated with VOCs, is direct inhalation and contact by humans and biota at or near the ground surface. A site-specific analysis should be conducted to determine whether SVE system operation or other remedial action should be taken or continued to protect receptors from this type of exposure.

Any VOCs remaining in the vadose zone after a decision is made to stop or not start an SVE system must be managed to the degree necessary in relation to its significance. Where the cleanup does not meet unrestricted reuse cleanup standards, management measures, such as institutional controls should be evaluated and implemented if necessary.

In addition to the methods and criteria for analysis presented in these Start/Stop procedures, a separate analysis that addresses other routes of exposure identified in the conceptual site model needs to be conducted and considered in making the decision to begin or continue SVE.

For protection of groundwater quality at McClellan, there are three cases to be considered:

Case #1 - Volatile Organic Compounds (VOC) contamination in the vadose zone over groundwater contaminated with the same VOC contaminant(s) of concern (COCs)
Case #2 - VOC contamination in the vadose zone over clean groundwater

Case #3 – Some or all VOC contamination in the vadose zone over groundwater contaminated with different COCs.

The SVE turn-off criteria presented below are for Case #1 to determine if SVE should be continued or terminated. For SVE turn-off criteria for the other cases, see documents:

SVE TURN-OFF (STOP) CRITERIA – Criteria for Case #2; and
SVE TURN-OFF (STOP) CRITERIA – Criteria for Case #3

This analysis applies to sites at McClellan AFB that meet the conditions for Case #1 that are addressed in the *Final McClellan Basewide VOC Record of Decision* (VOC ROD). The need to continue operation of an SVE system shall be evaluated at each site or group of sites. This evaluation will be called an SVE Termination or Optimization Process (STOP) and will be considered a primary document under the Federal Facilities Agreement and it may formally document site closure.

The STOP should be conducted after all the parties agree that:

- The site has been adequately characterized;
- The site does not pose an unacceptable risk to human health;
- The SVE system has been optimally designed;
- Performance monitoring indicates that the site conceptual model is accurate;
- Contaminant removal rates have stabilized and approached asymptotic levels, following one or more temporary shutdown periods; and
- The SVE system has been optimized to the greatest extent possible.

The decision to continue operation for an SVE system will depend upon the analysis of the three criteria listed below. It is always technically possible to remove more mass, but eventually whether to continue operations requires evaluating the tradeoff between certain monetary expenditure and uncertain environmental benefit. If the remaining contaminant mass in the vadose zone is predicted to not reach the groundwater, additional remediation will not be warranted.

If the contaminant concentration in the leachate entering the aquifer from the vadose zone is below the aquifer cleanup level selected in the VOC ROD, the aquifer will not be unacceptably degraded further. Lower cleanup levels may be achievable, but the additional cleanup required to reach them would likely not be justified. Several lines of evidence must be used to make this professional judgment since measuring actual leachate concentrations may be technically impractical and predicting leachate concentrations via modeling might be inaccurate.

Decision Criteria

The decision to continue SVE will be based on scientific, economic, and engineering judgment using the following criteria in sequence. The Air Force and the regulatory agencies acknowledge that there is uncertainty inherent in all of the elements used in the STOP, and that consensus is necessary to determine the levels of uncertainty that are acceptable in each of the elements.

I. Will the residual mass in the vadose zone reach the groundwater?

To answer this question, STOP elements "A" through "F" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes" or "unknown", then proceed to criterion II.

II. Will the residual mass in the vadose zone cause the contaminant concentrations in the leachate to exceed the aquifer cleanup level?

To answer this question, STOP elements "A" through "G" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes", or "unknown", then proceed to criterion III which requires a complete STOP.

III. Based on an evaluation of all of the elements, is it appropriate to permanently shut-off the SVE System?

To answer this question, all STOP elements must be addressed.

- If the answer is "yes", then shut off the SVE system and proceed with site closure.
- If the answer is "no" continue SVE operation or develop an alternate remedial strategy.

Elements of the STOP

The following elements should be applied to evaluate the criteria listed above.

A. What is the estimated residual contaminant mass and areal and vertical extent of the remaining vadose zone contaminant plume? Include contaminant isoconcentration maps and plume cross-sections to illustrate the contaminant concentrations and distribution in the subsurface.

B. Do the data indicate migration towards the groundwater? Qualitative answers to this question may be either "yes", "no" or "unable to make a determination". Evidence for migration towards groundwater may include such lines of evidence as: 1) increasing contaminant concentrations in onsite monitoring wells; 2) pre-remediation soil gas profiles from nested wells to estimate the contaminant's propensity for migration; and 3) post-remediation time-series profiles of soil gas concentrations in nested wells.

C. What is the lithology of areas that do and do not demonstrate rebounds in soil gas concentration? Use site-specific information, and include as much information as possible, such as porosity, moisture content and carbon content of soil, etc.

D. What are the actual site-specific infiltration and percolation rates? If site-specific data are not available, what are the predicted rates?

E. Are there sufficient historical groundwater monitoring data for wells at or adjacent to the site to determine whether the vadose zone plume has or has not impacted the groundwater? (This determination may not be possible due to active groundwater extraction in the area.)

F. Are there any other site-specific factors that should be considered in the evaluation such as site history and physical characteristics (e.g. organic carbon, biodegradation)? Factors to consider for this element include: 1) the nature of the release (for example: one-time spill or continued release over time?; how long ago the release occurred or ceased?; was the release to surface soil, or through

a conduit to the subsurface such as a French drain, dry well, or leaking sewer line?, etc.) and 2) any site-specific physical characteristics that may enhance or retard the contaminant's subsurface migration (such as unusual presence or absence of low permeability layers, high carbon content of soil, etc.).

G. What is the actual or predicted concentration and mass flux rate of leachate leaving the vadose zone? What is the concentration trend of leachate over time based on field data and modeling?

H. What was the mass removal rate prior to SVE shutdown?

I. What are the VOC concentration and cumulative mass removed expressed as a function of time?

J. How much money has been spent to date on the site's remediation?

K. Are further enhancements to the SVE systems predicted to be technically- or cost-effective?

L. What are the locations and capture zones of operating groundwater extraction wells relative to the vadose zone contaminant plume? Will the existing groundwater wells effectively (i.e., technically and economically) capture the contaminants from the site? If not, what are the additional costs to add groundwater wells?

M. What is the incremental cost over time of continued vadose zone remediation compared to the incremental cost over time for additional groundwater remediation provided that the underlying contamination has not reached aquifer cleanup levels? In other words, will the residual mass in the vadose zone significantly prolong the time and increase the cost to attain the aquifer cleanup level?

To implement element "M" the following costs need to be calculated:

- The cost (GW_1) to reach the aquifer cleanup level *with* the additional impact from the site (assume SVE will not be continued);
- The cost (GW_2) to reach the aquifer cleanup level *with* the additional impact from the site after an additional period of SVE operation; and
- The cost (SVE_1) of the additional SVE operation.

These costs can be calculated following the steps outlined below:

1. Using the measured residual soil gas concentrations at the site, calculate the mass of the residual contaminant in the vadose zone (same as element "A").

2. Estimate the site's potential impact to groundwater using appropriate vadose zone and groundwater fate and transport models.

3. Estimate the time to reach the groundwater aquifer cleanup level using the modeling results obtained in step 2 above.

4. Estimate the monthly cost to continue operation of the groundwater extraction system in the area impacted by the site.

5. Calculate the cost to reach aquifer cleanup level *with* the additional impact from the site (GW_1), because SVE will not continue to be operated. (GW_1 = (step 3 x step 4) plus element L)

6. Estimate the monthly cost of continuing to operate the SVE system based on historical costs (including operation and shutdown periods for the site).

7. Estimate the cost to operate the SVE system for an agreed-upon additional length of time that is based on site-specific conditions, such as 6 months (SVE_1), by multiplying the agreed-upon length of time by the results of step 6. (SVE_1 = length of time x step 6).

8. Estimate what the predicted residual soil gas concentrations would be if the SVE system were operated for the additional agreed-upon length of time.

9. Estimate the impact to groundwater from the site based on the results of step 8. This estimation can be conducted similarly to step 2 above.

10. Estimate the predicted time required for groundwater extraction system to reach aquifer cleanup level *with* the additional impact from the site assuming operation of the SVE system for the additional period of time agreed upon in step 7.

11. Calculate the cost to reach the aquifer cleanup level (GW_2) *with* the additional impact from the site assuming operation of the SVE system for an additional period of time. This cost is calculated by multiplying the results of step 10 by the results of step 4. (GW_2 = step 10 x step 4).

12. Compare the costs to reach the aquifer cleanup level *with* the additional impact from the site to the costs of continuing to operate a SVE system plus the cost to reach the aquifer cleanup level *with* the additional impact from the site after operation of the SVE system for an additional period of time. Mathematically this can be expressed as:

$$\text{Is } GW_1 > SVE_1 + GW_2 ?$$

If GW_1 is greater than (SVE_1 + GW_2), additional operation of the SVE system should be strongly considered.

Implementation

The Air Force will operate the SVE system until it demonstrates that the cleanup goal set forth above has been met. The Air Force, the USEPA, and the State (DTSC and the RWQCB) will jointly decide based on the STOP evaluation whether the SVE system may be permanently shut off. The STOP should be implemented in a phased approach, with the less complex criteria (criteria I and II described above) being evaluated first. Evaluation of these two criteria may indicate that the SVE system can be shut off, without having to perform a complete STOP (criterion III).

There are several potential outcomes of the STOP evaluation. Ideally, the STOP would indicate that the SVE system could be permanently turned off, and all parties agree that the site could be closed. Another potential outcome is that the STOP would indicate that the SVE system could be permanently shut off, but that the site may not yet be suitable for closure, based on remaining threats to the environment or water quality. In this case, additional discussion between the parties is necessary to determine what course of action is warranted, such as alternate remedial measures or long-term monitoring. The STOP may also indicate that additional SVE is warranted at the site prior to permanent system shut off.

Due to the reliance of the STOP on professional judgment, another outcome of the STOP is that the parties may not agree on whether the SVE system can be shut off or not. If the parties cannot reach a joint resolution, any party may invoke dispute resolution.

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SVE TURN-ON (START) CRITERIA
Criteria for Case #2

VOC Contamination in the Vadose Zone Over Clean Groundwater

Introduction

There are a number of factors that can influence the decision to install and operate soil vapor extraction (SVE) at a site where contaminant levels exceed human health or water quality screening threshold criteria. The McClellan AFB SVE start/stop criteria focuses on the analysis of soil vapor extraction (SVE) systems for the remediation of volatile organic compound (VOC) contamination in the vadose zone as it relates to groundwater cleanup and protection. For the protection of groundwater quality the issue becomes: is it technically and economically feasible to install and operate an SVE system to remediate the site?

In addition to the impact on groundwater, under CERCLA there are a number of factors that must be evaluated to arrive at the decision to install and operate an SVE system. These factors are brought out when the feasibility study and the conceptual site model are developed for the site. To ensure that all the factors are considered in the decision to initiate, continue or stop an SVE system, the conceptual site model should be included as an integral tool to be used in the decision-making process.

A typical potential route of exposure, that is present when the vadose zone is contaminated with VOCs, is direct inhalation and contact by humans and biota at or near the ground surface. A site-specific analysis should be conducted to determine whether SVE system operation or other remedial action should be taken or continued to protect receptors from this type of exposure.

Any VOCs remaining in the vadose zone after a decision is made to stop or not start an SVE system must be managed to the degree necessary in relation to its significance. Where the cleanup does not meet unrestricted reuse cleanup standards, management measures, such as institutional controls should be evaluated and implemented if necessary.

In addition to the methods and criteria for analysis presented in these Start/Stop procedures, a separate analysis that addresses other routes of exposure identified in the conceptual site model needs to be conducted and considered in making the decision to begin or continue SVE.

For protection of groundwater quality at McClellan, there are three cases to be considered:

Case #1 - Volatile Organic Compounds (VOC) contamination in the vadose zone over groundwater contaminated with the same VOC contaminant(s) of concern (COCs).
Case #2 - VOC contamination in the vadose zone over clean groundwater.
Case #3 – Some or all VOC contamination in the vadose zone over groundwater contaminated with different COCs.

The SVE turn-on criteria presented below are for Case #2 to determine if SVE should be implemented. For SVE turn-on criteria for the other cases, see documents:

SVE TURN-ON (START) CRITERIA – Criteria for Case #1; and
SVE TURN-ON (START) CRITERIA – Criteria for Case #3

The *McClellan Basewide Feasibility Study Report* (December 1999, FS) identified SVE as the preferred remedial technology for these sites. However the FS used a conservative screening analysis for the remedy selection that did not fully evaluate the practicality of SVE implementation on a site-by-site basis. The criteria below were developed to determine the technical and economical feasibility of SVE for Case #2. The criteria below will be used to determine whether SVE should be implemented for Case #2 at a particular site. This evaluation will be called a "START" and will be a primary document under the Federal Facilities Agreement (FFA).

This analysis applies to sites at McClellan AFB that meet the conditions for Case #2 that are addressed in the *Final McClellan Basewide VOC Record of Decision* (VOC ROD).

The START should be conducted after all the parties agree that:

- The site has been adequately characterized;
- The risk assessment indicates that site contaminants pose a potential threat to either human health and/or the environment, including water quality.
- The FS indicated that SVE is the remedy most suited to remediate the site.

The decision to install and operate an SVE system will depend upon the analysis of the three criteria listed below. It is always technically possible to remove mass, but installing and operating an SVE system requires evaluating the tradeoff between certain monetary expenditure and uncertain environmental benefit. If the contaminant mass in the vadose zone is predicted to not reach the groundwater, remediation will not be warranted.

If the contaminant concentration in the leachate entering the aquifer from the vadose zone is greater than non-detectable concentrations (i.e., is detectable based on laboratory practical quantitation limits), but below the aquifer cleanup level selected in the VOC ROD, the aquifer may be unacceptably degraded, and remediation may be warranted. If the leachate concentration is above the aquifer cleanup levels selected in the VOC ROD, remediation may be warranted. Several lines of evidence must be used to make this professional judgment since measuring actual leachate concentrations may be technically impractical and predicting leachate concentrations via modeling might be inaccurate.

The Regional Board acknowledges that at sites subject to these SVE turn-on (START) criteria, some degradation of the groundwater may occur. The process for the application of the criteria is intended to result in reasonable protection of the beneficial uses of waters of the State as further described in the *Final McClellan Basewide VOC ROD*.

Case #2 addresses VOC contamination in the vadose zone over clean groundwater and assumes that groundwater treatment has not been implemented at the site. To complete the START process the Air

Force and regulatory agencies must evaluate the cost to construct and operate a groundwater treatment system. The groundwater treatment system would capture groundwater contaminated above the aquifer clean-up level selected in the VOC ROD caused by the vadose zone contamination.

Decision Criteria

The decision to install and operate SVE will be based on scientific, economic, and engineering judgment using the following criteria in sequence. The Air Force and the regulatory agencies acknowledge that there is uncertainty inherent in all of the elements used in the START, and that consensus is necessary to determine the levels of uncertainty that are acceptable in each of the elements.

I. Will the contaminant mass in the vadose zone reach the groundwater, based on either a screening level or site-specific evaluation?

To answer this question, START elements "A" through "G" must be addressed.
- If the answer is "no", then proceed with site closure.
- If the answer is "yes" or "unknown", then proceed to criterion II.

II. Will the contaminant mass in the vadose zone cause the contaminant concentrations in the leachate to exceed *non-detectable concentrations* (i.e., is detectable based on laboratory practical quantitation limits)?

To answer this question, START elements "A" through "H" must be addressed.
- If the answer is "no", then proceed with site closure.
- If the answer is "yes", or "unknown", then proceed to criterion III which requires a complete START.

III. Based on an evaluation of all of the elements, is it appropriate to install and operate an SVE system at the site?

To answer this question, all START elements must be addressed.
- If the answer is "yes", then proceed with SVE system installation and operation.
- If the answer is "no" proceed with site closure negotiations.

Elements of the START

The following elements should be applied to evaluate the criteria listed above.

A. Are there any time- or land use-critical re-use issues with the site, and if so, what are they? These types of issues may preclude the need for further analysis, if SVE is required to address these concerns.

B. What is the estimated contaminant mass and areal and vertical extent of the vadose zone contaminant plume? Include contaminant isoconcentration maps and plume cross-sections to illustrate the contaminant concentrations and distribution in the subsurface.

C. Do the data indicate contaminant migration towards the groundwater? Qualitative answers to this question may be either "yes", "no" or "unable to make a determination". Evidence for migration towards groundwater may include such lines of evidence as: 1) increasing contaminant concentrations in onsite monitoring wells; 2) soil gas profiles from nested wells to estimate the contaminant's propensity for migration; and 3) time-series profiles of soil gas concentrations in nested wells.

D. What is the lithology of areas that demonstrate significant soil gas concentrations of contaminants? Use site-specific information, and include as much information as possible, such as porosity, moisture content and carbon content of soil, etc.

E. What are the actual site-specific infiltration and percolation rates? If site-specific data are not available, what are the predicted rates?

F. Are there sufficient historical groundwater monitoring data for wells at or adjacent to the site to determine whether the vadose zone plume has or has not impacted the groundwater? (This determination may not be possible due to active groundwater extraction in the area.)

G. Are there any other site-specific factors that should be considered in the evaluation such as site history and physical characteristics (e.g. organic carbon, biodegradation)? Factors to consider for this element include: 1) the nature of the release (for example: one-time spill or continued release over time?; how long ago the release occurred or ceased?; was the release to surface soil, or through a conduit to the subsurface such as a French drain, dry well, or leaking sewer line?, etc.); and 2) any site-specific physical characteristics that may enhance or retard the contaminant's subsurface migration (such as unusual presence or absence of low permeability layers, high carbon content of soil, etc.).

H. What is the actual or predicted concentration and mass flux rate of leachate leaving the vadose zone? What is the predicted concentration trend of leachate over time based on modeling?

I. Qualitatively, what is the estimated SVE effectiveness of a system, based on known information and experience from similar sites?

J. How much money, if any, has been spent to date on the site's remediation?

K. What is the estimated cost to install an SVE system?

L. What are the locations and capture zones of operating groundwater extraction wells relative to the vadose zone contaminant plume? Will the existing groundwater wells effectively (i.e., technically and economically) capture the contaminants from the site? If not, what are the additional costs to add groundwater extraction wells and a treatment system, if necessary?

M. What is the cost of vadose zone remediation compared to the cost for groundwater remediation due to impacts from the site.

To implement element "M" the following costs need to be calculated:

- The cost (GW_1) to reach the aquifer cleanup level *with* the additional impact from the site; (assume SVE will not be implemented).
- The cost (SVE_1) of SVE installation and operation.

These costs can be calculated following the steps outlined below:

1. Using the measured soil gas concentrations at the site, calculate the mass of the contaminant in the vadose zone (same as element "B").

2. Estimate the site's potential impact to groundwater using appropriate vadose zone and groundwater fate and transport models.

3. Estimate the time to reach the groundwater aquifer cleanup level using the modeling results obtained in step 2 above.

4. Estimate the monthly cost to operate a groundwater extraction system in the area impacted by the site?

5. Calculate the cost to reach the aquifer cleanup level *with* the additional impact from the site (GW_1), because SVE will not be installed and operated. (GW_1 = (step 3 x step 4) plus element L).

6. Estimate the monthly cost to operate the SVE system based on historical costs from similar sites (including all costs relating to operation and shutdown).

7. Estimate the cost to install an SVE system and operate for an estimated length of time that is based on site-specific conditions, to achieve site cleanup. (SVE_1 = length of time x step 6 plus cost to install SVE, i.e., element K)

8. Compare the costs of groundwater extraction *without* SVE at the site to the costs of SVE at the site. Mathematically, this can be expressed as:

$$\text{Is } (GW_1) > (SVE_1) \text{ ?}$$

If (GW_1) is greater than (SVE_1), installation and operation of an SVE system should be strongly considered.

Implementation

The Air Force, the USEPA, and the State (DTSC and the RWQCB) will jointly decide, based on the START evaluation, whether the SVE system should or should not be installed at the site. The START should be implemented in a phased approach, with the less complex criteria (criteria I and II described above) being evaluated first. Evaluation of these two criteria may indicate that the SVE system is not necessary, without having to perform a complete START (criterion III).

There are several potential outcomes of the START evaluation. Ideally, the START would indicate unequivocally that either the SVE system would not be necessary, and all parties agree that the site could be closed, or that SVE is warranted at the site and should be installed and operated. Another potential outcome is that the START would indicate that the SVE system is not economically or technically justified, but that the site may not yet be suitable for closure, based on remaining threats to the environment or water quality. In this case, additional discussion between the parties is necessary to determine what course of action is warranted, such as alternate remedial measures or long-term monitoring.

Due to the reliance of the START on professional judgment, another outcome of the START is that the parties may not agree on whether the SVE system should be installed or not. If the parties cannot reach a joint resolution, any party may invoke dispute resolution.

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SVE TURN-OFF (STOP) CRITERIA
Criteria for Case #2

VOC Contamination in the Vadose Zone Over Clean Groundwater

Introduction

There are a number of factors that can influence the decision to continue to operate soil vapor extraction (SVE) at a site where contaminant levels exceed human health or water quality screening threshold criteria. The McClellan AFB SVE start/stop criteria focuses on the analysis of soil vapor extraction (SVE) systems for the remediation of volatile organic compound (VOC) contamination in the vadose zone as it relates to groundwater cleanup and protection. For the protection of groundwater quality the issue becomes: is it technically and economically feasible to continue to operate an SVE system to remediate the site?

In addition to the impact on groundwater, under CERCLA there are a number of factors that must be evaluated to arrive at the decision to install and operate an SVE system. These factors are brought out when the feasibility study and the conceptual site model are developed for the site. To ensure that all the factors are considered in the decision to initiate, continue or stop an SVE system, the conceptual site model should be included as an integral tool to be used in the decision-making process.

A typical potential route of exposure, that is present when the vadose zone is contaminated with VOCs, is direct inhalation and contact by humans and biota at or near the ground surface. A site-specific analysis should be conducted to determine whether SVE system operation or other remedial action should be taken or continued to protect receptors from this type of exposure.

Any VOCs remaining in the vadose zone after a decision is made to stop or not start an SVE system must be managed to the degree necessary in relation to its significance. Where the cleanup does not meet unrestricted reuse cleanup standards, management measures, such as institutional controls should be evaluated and implemented if necessary.

In addition to the methods and criteria for analysis presented in these Start/Stop procedures, a separate analysis that addresses other routes of exposure identified in the conceptual site model needs to be conducted and considered in making the decision to begin or continue SVE.

For protection of groundwater quality at McClellan, there are three cases to be considered:

Case #1 - Volatile Organic Compounds (VOC) contamination in the vadose zone over groundwater contaminated with the same VOC contaminant(s) of concern (COCs)
Case #2 - VOC contamination in the vadose zone over clean groundwater
Case #3 - Some or all VOC contamination in the vadose zone over groundwater contaminated with different COCs.

The SVE turn-off criteria presented below are for Case #2 to determine if SVE should be continued or terminated. For SVE turn-off criteria for the other cases, see documents:

SVE TURN-OFF (STOP) CRITERIA – Criteria for Case #1; and
SVE TURN-OFF (STOP) CRITERIA – Criteria for Case #3

This analysis applies to sites at McClellan AFB that meet the conditions for Case #2 that are addressed in the *Final McClellan Basewide VOC Record of Decision* (VOC ROD). The need to continue operation of an SVE system shall be evaluated at each site or group of sites. This evaluation will be called an SVE Termination or Optimization Process (STOP) and will be considered a primary document under the Federal Facilities Agreement and it may formally document site closure.

The STOP should be conducted after all the parties agree that:

- The site has been adequately characterized;
- The site does not pose an unacceptable risk to human health;
- The SVE system has been optimally designed;
- Performance monitoring indicates that the site conceptual model is accurate;
- Contaminant removal rates have stabilized and approached asymptotic levels, following one or more temporary shutdown periods; and
- The SVE system has been optimized to the greatest extent possible.

The decision to continue operation for an SVE system will depend upon the analysis of the three criteria listed below. It is always technically possible to remove more mass, but eventually whether to continue operations requires evaluating the tradeoff between certain monetary expenditure and uncertain environmental benefit. If the remaining contaminant mass in the vadose zone is predicted to not reach the groundwater, additional remediation will not be warranted.

If the contaminant concentration in the leachate entering the aquifer from the vadose zone is greater than non-detectable concentrations (i.e., is detectable based on laboratory practical quantitation limits), but below the aquifer cleanup level selected in the VOC ROD, the aquifer may be unacceptably degraded, and continued remediation may be warranted. If the leachate concentration is above the aquifer cleanup levels selected in the VOC ROD, continued remediation may be warranted. Several lines of evidence must be used to make this professional judgment since measuring actual leachate concentrations may be technically impractical and predicting leachate concentrations via modeling might be inaccurate.

The Regional Board acknowledges that at sites subject to these SVE turn-off (STOP) criteria, some degradation of the groundwater may occur. The process for the application of the criteria is intended to result in reasonable protection of the beneficial uses of waters of the State as further described in the *Final McClellan Basewide VOC ROD.*

Case #2 addresses VOC contamination in the vadose zone over clean groundwater and assumes that groundwater treatment has not been implemented at the site. To complete the STOP process the Air Force and regulatory agencies must evaluate the cost to construct and operate a groundwater treatment system. The groundwater treatment system would capture groundwater contaminated above the aquifer clean-up level selected in the VOC ROD caused by the vadose zone contamination.

Decision Criteria

The decision to continue SVE will be based on scientific, economic, and engineering judgment using the following criteria in sequence. The Air Force and the regulatory agencies acknowledge that there is uncertainty inherent in all of the elements used in the STOP, and that consensus is necessary to determine the levels of uncertainty that are acceptable in each of the elements.

I. Will the residual mass in the vadose zone reach the groundwater?

To answer this question, STOP elements "A" through "F" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes" or "unknown", then proceed to criterion II.

II. Will the residual mass in the vadose zone cause the contaminant concentrations in the leachate to exceed *non-detectable concentrations* (i.e., is detectable based on laboratory practical quantitation limits)?

To answer this question, STOP elements "A" through "G" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes", or "unknown", then proceed to criterion III which requires a complete STOP.

III. Based on an evaluation of all of the elements, is it appropriate to permanently shut-off the SVE System?

To answer this question, all STOP elements must be addressed.

- If the answer is "yes", then shut off the SVE system and proceed with site closure.
- If the answer is "no" continue SVE operation or develop an alternate remedial strategy.

Elements of the STOP

The following elements should be applied to evaluate the criteria listed above.

A. What is the estimated residual contaminant mass and areal and vertical extent of the remaining vadose zone contaminant plume? Include contaminant isoconcentration maps and plume cross-sections to illustrate the contaminant concentrations and distribution in the subsurface.

B. Do the data indicate migration towards the groundwater? Qualitative answers to this question may be either "yes", "no" or "unable to make a determination". Evidence for migration towards groundwater may include such lines of evidence as: 1) increasing contaminant concentrations in onsite monitoring wells; 2) pre-remediation soil gas profiles from nested wells to estimate the contaminant's propensity for migration; and 3) post-remediation time-series profiles of soil gas concentrations in nested wells.

C. What is the lithology of areas that do and do not demonstrate rebounds in soil gas concentration? Use site-specific information, and include as much information as possible, such as porosity, moisture content and carbon content of soil, etc.

D. What are the actual site-specific infiltration and percolation rates? If site-specific data are not available, what are the predicted rates?

E. Are there sufficient historical groundwater monitoring data for wells at or adjacent to the site to determine whether the vadose zone plume has or has not impacted the groundwater? (This determination may not be possible due to active groundwater extraction in the area.)

F. Are there any other site-specific factors that should be considered in the evaluation such as site history and physical characteristics (e.g. organic carbon, biodegradation)? Factors to consider for this element include: 1) the nature of the release (for example: one-time spill or continued release over time?; how long ago the release occurred or ceased?; was the release to surface soil, or through a conduit to the subsurface such as a French drain, dry well, or leaking sewer line?, etc.) and 2) any site-specific physical characteristics that may enhance or retard the contaminant's subsurface migration (such as unusual presence or absence of low permeability layers, high carbon content of soil, etc.).

G. What is the actual or predicted concentration and mass flux rate of leachate leaving the vadose zone? What is the concentration trend of leachate over time based on field data and modeling?

H. What was the mass removal rate prior to SVE shutdown?

I. What are the VOC concentration and cumulative mass removed expressed as a function of time?

J. How much money has been spent to date on the site's remediation?

K. Are further enhancements to the SVE systems predicted to be technically- or cost-effective?

L. What are the locations and capture zones of operating groundwater extraction wells relative to the vadose zone contaminant plume? Will the existing groundwater wells effectively (i.e., technically and economically) capture the contaminants from the site? If not, what are the additional costs to add groundwater extraction wells and a treatment system, if necessary?

M. What is the cost of vadose zone remediation compared to the cost for groundwater remediation due to impacts from the site.

To implement element "M" the following costs need to be calculated:

- The cost (GW_1) to reach the aquifer cleanup level *with* the additional impact from the site; (assume SVE will not be continued).
- The cost (SVE_1) of the additional SVE operation.

These costs can be calculated following the steps outlined below:

1. Using the measured residual soil gas concentrations at the site, calculate the mass of the residual contaminant in the vadose zone (same as element "A").

2. Estimate the site's potential impact to groundwater using appropriate vadose zone and groundwater fate and transport models.

3. Estimate the time to reach the groundwater aquifer cleanup level using the modeling results obtained in step 2 above.

4. Estimate the monthly cost to operate a groundwater extraction system in the area impacted by the site?

5. Calculate the cost to reach aquifer cleanup level *with* the additional impact from the site (GW_1), because SVE will not continue to be operated. (GW_1 = (step 3 x step 4) plus element L)

6. Estimate the monthly cost of continuing to operate the SVE system based on historical costs (including all costs relating to operation and shutdown).

7. Estimate the cost to operate the SVE system for an agreed-upon additional length of time to achieve site cleanup that is based on site-specific conditions. (SVE_1 = length of time x step 6)

8. Compare the costs of groundwater extraction *without* additional SVE at the site to the costs of continuing SVE at the site. Mathematically, this can be expressed as:

$$\text{Is } (GW_1) > (SVE_1) \text{ ?}$$

If (GW_1) is greater than (SVE_1), additional operation of the SVE system should be strongly considered.

Implementation

The Air Force will operate the SVE system until it demonstrates that the cleanup goal set forth above has been met. The Air Force, the USEPA, and the State (DTSC and the RWQCB) will jointly decide based on the STOP evaluation whether the SVE system may be permanently shut off. The STOP should be implemented in a phased approach, with the less complex criteria (criteria I and II described above) being evaluated first. Evaluation of these two criteria may indicate that the SVE system can be shut off, without having to perform a complete STOP (criterion III).

There are several potential outcomes of the STOP evaluation. Ideally, the STOP would indicate that the SVE system could be permanently turned off, and all parties agree that the site could be closed. Another potential outcome is that the STOP would indicate that the SVE system could be permanently shut off, but that the site may not yet be suitable for closure, based on remaining threats to the environment or water quality. In this case, additional discussion between the parties is necessary to determine what course of action is warranted, such as alternate remedial measures or long-term monitoring. The STOP may also indicate that additional SVE is warranted at the site prior to permanent system shut off.

Due to the reliance of the STOP on professional judgment, another outcome of the STOP is that the parties may not agree on whether the SVE system can be shut off or not. If the parties cannot reach a joint resolution, any party may invoke dispute resolution.

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SVE TURN-ON (START) CRITERIA
Criteria for Case #3

Some or All VOC Contamination in the Vadose Zone Over Groundwater Contaminated with Different COCs

Introduction

There are a number of factors that can influence the decision to install and operate soil vapor extraction (SVE) at a site where contaminant levels exceed human health or water quality screening threshold criteria. The McClellan AFB SVE start/stop criteria focuses on the analysis of soil vapor extraction (SVE) systems for the remediation of volatile organic compound (VOC) contamination in the vadose zone as it relates to groundwater cleanup and protection. For the protection of groundwater quality the issue becomes: is it technically and economically feasible to install and operate an SVE system to remediate the site?

In addition to the impact on groundwater, under CERCLA there are a number of factors that must be evaluated to arrive at the decision to install and operate an SVE system. These factors are brought out when the feasibility study and the conceptual site model are developed for the site. To ensure that all the factors are considered in the decision to initiate, continue or stop an SVE system, the conceptual site model should be included as an integral tool to be used in the decision-making process.

A typical potential route of exposure, that is present when the vadose zone is contaminated with VOCs, is direct inhalation and contact by humans and biota at or near the ground surface. A site-specific analysis should be conducted to determine whether SVE system operation or other remedial action should be taken or continued to protect receptors from this type of exposure.

Any VOCs remaining in the vadose zone after a decision is made to stop or not start an SVE system must be managed to the degree necessary in relation to its significance. Where the cleanup does not meet unrestricted reuse cleanup standards, management measures, such as institutional controls should be evaluated and implemented if necessary.

In addition to the methods and criteria for analysis presented in these Start/Stop procedures, a separate analysis that addresses other routes of exposure identified in the conceptual site model needs to be conducted and considered in making the decision to begin or continue SVE.

For protection of groundwater quality at McClellan, there are three cases to be considered:

Case #1 - Volatile Organic Compounds (VOC) contamination in the vadose zone over groundwater contaminated with the same VOC contaminant(s) of concern (COCs)

Case #2 - VOC contamination in the vadose zone over clean groundwater
Case #3 – Some or all VOC contamination in the vadose zone over groundwater contaminated with different COCs.

The SVE turn-on criteria presented below are for Case #3 to determine if SVE should be implemented. For SVE turn-on criteria for the other cases, see documents:

SVE TURN-ON (START) CRITERIA – Criteria for Case #1; and
SVE TURN-ON (START) CRITERIA – Criteria for Case #2

The *McClellan Basewide Feasibility Study Report* (December 1999, FS) identified SVE as the preferred remedial technology for these sites. However the FS used a conservative screening analysis for the remedy selection that did not fully evaluate the practicality of SVE implementation on a site-by-site basis. The criteria below were developed to determine the technical and economical feasibility of SVE for Case #3. The criteria below will be used to determine whether SVE should be implemented for Case #3 at a particular site. This evaluation will be called a "START" and will be a primary document under the Federal Facilities Agreement (FFA).

This analysis applies to sites at McClellan AFB that meet the conditions for Case #3 that are addressed in the *Final McClellan Basewide VOC Record of Decision* (VOC ROD).

The START should be conducted after all the parties agree that:

- The site has been adequately characterized;
- The risk assessment indicates that site contaminants pose a potential threat to either human health and/or the environment, including water quality.
- The FS indicated that SVE is the remedy most suited to remediate the site.

The decision to install and operate an SVE system will depend upon the analysis of the three criteria listed below. It is always technically possible to remove mass, but installing and operating an SVE system requires evaluating the tradeoff between certain monetary expenditure and uncertain environmental benefit. If the contaminant mass in the vadose zone is predicted to not reach the groundwater, remediation will not be warranted.

If the contaminant concentration in the leachate entering the aquifer from the vadose zone is greater than non-detectable concentrations (i.e., is detectable based on laboratory practical quantitation limits) for the COCs not already in the groundwater, but below the aquifer cleanup level selected in the VOC ROD, the aquifer may be unacceptably degraded, and remediation may be warranted. If the leachate concentration is above the aquifer cleanup levels selected in the VOC ROD, remediation may be warranted. Several lines of evidence must be used to make this professional judgment since measuring actual leachate concentrations may be technically impractical and predicting leachate concentrations via modeling might be inaccurate.

The Regional Board acknowledges that at sites subject to these SVE turn-on (START) criteria, some degradation of the groundwater may occur. The process for the application of the criteria is intended to

result in reasonable protection of the beneficial uses of waters of the State as further described in the *Final McClellan Basewide VOC ROD.*

Case #3 addresses VOC contamination in the vadose zone over groundwater contaminated with different COCs. Case #3 is similar to Case #1. The difference is that in Case #3, further evaluation is required if the contaminant concentration in the leachate entering the aquifer from the vadose zone is greater than *non-detectable concentrations* (i.e., is detectable based on laboratory practical quantitation limits) for the COCs not already in the groundwater. In Case #1 no further evaluation is required if the contaminant concentration in the leachate entering the aquifer from the vadose zone is below the aquifer cleanup level selected in the ROD. This also applies to Case #3 for COCs already present in the groundwater.

Decision Criteria

The decision to install and operate SVE will be based on scientific, economic, and engineering judgment using the following criteria in sequence. The Air Force and the regulatory agencies acknowledge that there is uncertainty inherent in all of the elements used in the START, and that consensus is necessary to determine the levels of uncertainty that are acceptable in each of the elements.

I. Will the contaminant mass in the vadose zone reach the groundwater, based on either a screening level or site-specific evaluation?

To answer this question, START elements "A" through "G" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes" or "unknown", then proceed to criterion II.

II. Will the contaminant mass in the vadose zone cause the contaminant concentrations in the leachate to exceed *non-detectable concentrations* (i.e., detection is based on laboratory practical quantitation limits) for the COCs not already in the groundwater, or the aquifer cleanup level for the COCs already in the groundwater?

To answer this question, START elements "A" through "H" must be addressed.

- If the answer is "no", then proceed with site closure.
- If the answer is "yes", or "unknown", then proceed to criterion III which requires a complete START.

III. Based on an evaluation of all of the elements, is it appropriate to install and operate an SVE system at the site?

To answer this question, all START elements must be addressed.

- If the answer is "yes", then proceed with SVE system installation and operation.
- If the answer is "no" proceed with site closure negotiations.

Elements of the START

The following elements should be applied to evaluate the criteria listed above.

A. Are there any time- or land use-critical re-use issues with the site, and if so, what are they? These types of issues may preclude the need for further analysis, if SVE is required to address these concerns.

B. What is the estimated contaminant mass and areal and vertical extent of the vadose zone contaminant plume? Include contaminant isoconcentration maps and plume cross-sections to illustrate the contaminant concentrations and distribution in the subsurface.

C. Do the data indicate contaminant migration towards the groundwater? Qualitative answers to this question may be either "yes", "no" or "unable to make a determination". Evidence for migration towards groundwater may include such lines of evidence as: 1) increasing contaminant concentrations in onsite monitoring wells; 2) soil gas profiles from nested wells to estimate the contaminant's propensity for migration; and 3) time-series profiles of soil gas concentrations in nested wells.

D. What is the lithology of areas that demonstrate significant soil gas concentrations of contaminants? Use site-specific information, and include as much information as possible, such as porosity, moisture content and carbon content of soil, etc.

E. What are the actual site-specific infiltration and percolation rates? If site-specific data are not available, what are the predicted rates?

F. Are there sufficient historical groundwater monitoring data for wells at or adjacent to the site to determine whether the vadose zone plume has or has not impacted the groundwater? (This determination may not be possible due to active groundwater extraction in the area.)

G. Are there any other site-specific factors that should be considered in the evaluation such as site history and physical characteristics (e.g. organic carbon, biodegradation)? Factors to consider for this element include: 1) the nature of the release (for example: one-time spill or continued release over time?; how long ago the release occurred or ceased?; was the release to surface soil, or through a conduit to the subsurface such as a French drain, dry well, or leaking sewer line?, etc.); and 2) any site-specific physical characteristics that may enhance or retard the contaminant's subsurface migration (such as unusual presence or absence of low permeability layers, high carbon content of soil, etc.).

H. What is the actual or predicted concentration and mass flux rate of leachate leaving the vadose zone? What is the predicted concentration trend of leachate over time based on modeling?

I. Qualitatively, what is the estimated SVE effectiveness of a system, based on known information and experience from similar sites?

J. How much money, if any, has been spent to date on the site's remediation?

K. What is the estimated cost to install an SVE system?

L. What are the locations and capture zones of operating groundwater extraction wells relative to the vadose zone contaminant plume? Will the existing groundwater wells effectively (i.e., technically and economically) capture the COC contaminants from the site? If not, what are the additional costs to add groundwater extraction wells?

M. What is the cost of vadose zone remediation compared to the incremental cost for additional groundwater remediation due to impacts to the site from the vadose zone contamination. In other words, will the residual mass in the vadose zone significantly prolong the time and increase the cost to attain the aquifer cleanup level?

To implement element "M" the following costs need to be calculated:

- The cost (GW_1) to reach the aquifer clean-up level *with* the additional impact from the site; (assume SVE will not be implemented);
- The cost (GW_2) to reach the aquifer cleanup level *with* the additional impact from the site after a period of SVE operation; and
- The cost (SVE_1) of SVE installation and operation.

These costs can be calculated following the steps outlined below:

1. Using the measured soil gas concentrations at the site, calculate the mass of the contaminant in the vadose zone (same as element "B").

2. Estimate the site's potential impact to groundwater using appropriate vadose zone and groundwater fate and transport models.

3. Estimate the time to reach the groundwater aquifer clean-up level using the modeling results obtained in step 2 above.

4. Estimate the monthly cost to continue operation of the groundwater extraction system in the area impacted by the site.

5. Calculate the cost to reach the aquifer clean-up level *with* the additional impact from the site (GW_1), because SVE will not be installed and operated. (GW_1 = (step 3 x step 4) plus element L).

6. Estimate the monthly cost to operate the SVE system based on historical costs from similar sites (including all costs relating to operation and shutdown).

7. Estimate the cost to install an SVE system and operate for an estimated length of time that is based on site-specific conditions, such as 24 months. (SVE_1 = length of time x step 6 plus cost to install SVE, i.e., element K)

8. Estimate what the predicted residual soil gas concentrations would be if the SVE system were operated for the estimated length of time.

9. Estimate the impact to groundwater from the site based on the results of step 8. This estimation can be conducted similarly to step 2 above.

10. Estimate the predicted time required for groundwater extraction system to reach aquifer cleanup level *with* the additional impact from the site assuming operation of the SVE system for the period of time estimated in step 7.

11. Calculate the cost to reach the aquifer cleanup level (GW_2) *with* the additional impact from the site assuming operation of the SVE system for the estimated period of time. This cost is calculated by multiplying the results of step 10 by the results of step 4. (GW_2= step 10 x step 4)

12. Compare the costs to reach the aquifer cleanup level *with* the additional impact from the site to the costs of installing and operating an SVE system plus the cost to reach the aquifer cleanup level *with* the additional impact from the site after operation of the SVE system for an estimated period of time. Mathematically this can be expressed as:

$$\text{Is } GW_1 > SVE_1 + GW_2 \text{?}$$

If GW_1 is greater than (SVE_1 + GW_2), installation and operation of an SVE system should be strongly considered.

Implementation

The Air Force, the USEPA, and the State (DTSC and the RWQCB) will jointly decide, based on the START evaluation, whether the SVE system should or should not be installed at the site. The START should be implemented in a phased approach, with the less complex criteria (criteria I and II described above) being evaluated first. Evaluation of these two criteria may indicate that the SVE system is not necessary, without having to perform a complete START (criterion III).

There are several potential outcomes of the START evaluation. Ideally, the START would indicate unequivocally that either the SVE system would not be necessary, and all parties agree that the site could be closed, or that SVE is warranted at the site and should be installed and operated. Another potential outcome is that the START would indicate that the SVE system is not economically or technically justified, but that the site may not yet be suitable for closure, based on remaining threats to the environment or water quality. In this case, additional discussion between the parties is necessary to determine what course of action is warranted, such as alternate remedial measures or long-term monitoring.

Due to the reliance of the START on professional judgment, another outcome of the START is that the parties may not agree on whether the SVE system should be installed or not. If the parties cannot reach a joint resolution, any party may invoke dispute resolution.

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SVE TURN-OFF (STOP) CRITERIA
Criteria for Case #3

Some or All VOC Contamination in the Vadose Zone Over Groundwater Contaminated with Different COCs

Introduction

There are a number of factors that can influence the decision to continue to operate soil vapor extraction (SVE) at a site where contaminant levels exceed human health or water quality screening threshold criteria. The McClellan AFB SVE start/stop criteria focuses on the analysis of soil vapor extraction (SVE) systems for the remediation of volatile organic compound (VOC) contamination in the vadose zone as it relates to groundwater cleanup and protection. For the protection of groundwater quality the issue becomes: is it technically and economically feasible to continue to operate an SVE system to remediate the site?

In addition to the impact on groundwater, under CERCLA there are a number of factors that must be evaluated to arrive at the decision to install and operate an SVE system. These factors are brought out when the feasibility study and the conceptual site model are developed for the site. To ensure that all the factors are considered in the decision to initiate, continue or stop an SVE system, the conceptual site model should be included as an integral tool to be used in the decision-making process.

A typical potential route of exposure, that is present when the vadose zone is contaminated with VOCs, is direct inhalation and contact by humans and biota at or near the ground surface. A site-specific analysis should be conducted to determine whether SVE system operation or other remedial action should be taken or continued to protect receptors from this type of exposure.

Any VOCs remaining in the vadose zone after a decision is made to stop or not start an SVE system must be managed to the degree necessary in relation to its significance. Where the cleanup does not meet unrestricted reuse cleanup standards, management measures, such as institutional controls should be evaluated and implemented if necessary.

In addition to the methods and criteria for analysis presented in these Start/Stop procedures, a separate analysis that addresses other routes of exposure identified in the conceptual site model needs to be conducted and considered in making the decision to begin or continue SVE.

For protection of groundwater quality at McClellan, there are three cases to be considered:

Case #1 - Volatile Organic Compounds (VOC) contamination in the vadose zone over groundwater contaminated with the same VOC contaminant(s) of concern (COCs)
Case #2 - VOC contamination in the vadose zone over clean groundwater

Case #3 – Some or all VOC contamination in the vadose zone over groundwater contaminated with different COCs.

The SVE turn-off criteria presented below are for Case #3 to determine if SVE should be continued or terminated. For SVE turn-off criteria for the other cases, see documents:

SVE TURN-OFF (STOP) CRITERIA – Criteria for Case #1; and
SVE TURN-OFF (STOP) CRITERIA – Criteria for Case #2

This analysis applies to sites at McClellan AFB that meet the conditions for Case #3 that are addressed in the *Final McClellan Basewide VOC Record of Decision* (VOC ROD). The need to continue operation of an SVE system shall be evaluated at each site or group of sites. This evaluation will be called an SVE Termination or Optimization Process (STOP) and will be considered a primary document under the Federal Facilities Agreement and it may formally document site closure.

The STOP should be conducted after all the parties agree that:

- The site has been adequately characterized;
- The site does not pose an unacceptable risk to human health;
- The SVE system has been optimally designed;
- Performance monitoring indicates that the site conceptual model is accurate;
- Contaminant removal rates have stabilized and approached asymptotic levels, following one or more temporary shutdown periods; and
- The SVE system has been optimized to the greatest extent possible.

The decision to continue operation for an SVE system will depend upon the analysis of the three criteria listed below. It is always technically possible to remove more mass, but eventually whether to continue operations requires evaluating the tradeoff between certain monetary expenditure and uncertain environmental benefit. If the remaining contaminant mass in the vadose zone is predicted to not reach the groundwater, additional remediation will not be warranted.

If the contaminant concentration in the leachate entering the aquifer from the vadose zone is greater than non-detectable concentrations (i.e., is detectable based on laboratory practical quantitation limits) for the COCs not already in the groundwater, but below the aquifer cleanup level selected in the VOC ROD, the aquifer may be unacceptably degraded, and continued remediation may be warranted. If the leachate concentration is above the aquifer cleanup levels selected in the VOC ROD, continued remediation may be warranted. Several lines of evidence must be used to make this professional judgment since measuring actual leachate concentrations may be technically impractical and predicting leachate concentrations via modeling might be inaccurate.

The Regional Board acknowledges that at sites subject to these SVE turn-off (STOP) criteria, some degradation of the groundwater may occur. The process for the application of the criteria is intended to result in reasonable protection of the beneficial uses of waters of the State as further described in the *Final McClellan Basewide VOC ROD*.

Case #3 addresses VOC contamination in the vadose zone over groundwater contaminated with different COCs. Case #3 is similar to Case #1. The difference is that in Case #3, further evaluation is required if

the contaminant concentration in the leachate entering the aquifer from the vadose zone is greater than *non-detectable concentrations* (i.e., is detectable based on laboratory practical quantitation limits) for the COCs not already in the groundwater. In Case #1 no further evaluation is required if the contaminant concentration in the leachate entering the aquifer from the vadose zone is below the aquifer cleanup level selected in the ROD. This also applies to Case #3 for COCs already present in the groundwater.

Decision Criteria

The decision to continue SVE will be based on scientific, economic, and engineering judgment using the following criteria in sequence. The Air Force and the regulatory agencies acknowledge that there is uncertainty inherent in all of the elements used in the STOP, and that consensus is necessary to determine the levels of uncertainty that are acceptable in each of the elements.

I. Will the residual mass in the vadose zone reach the groundwater?

To answer this question, STOP elements "A" through "F" must be addressed.
- If the answer is "no", then proceed with site closure.
- If the answer is "yes" or "unknown", then proceed to criterion II.

II. Will the residual mass in the vadose zone cause the contaminant concentrations in the leachate to exceed *non-detectable concentrations* (i.e., is detectable based on laboratory practical quantitation limits) for the COCs not already in the groundwater, or the aquifer cleanup level for the COCs already in the groundwater?

To answer this question, STOP elements "A" through "G" must be addressed.
- If the answer is "no", then proceed with site closure.
- If the answer is "yes", or "unknown", then proceed to criterion III which requires a complete STOP.

III. Based on an evaluation of all of the elements, is it appropriate to permanently shut-off the SVE System?

To answer this question, all STOP elements must be addressed.
- If the answer is "yes", then shut off the SVE system and proceed with site closure.
- If the answer is "no" continue SVE operation or develop an alternate remedial strategy.

Elements of the STOP

The following elements should be applied to evaluate the criteria listed above.

A. What is the estimated residual contaminant mass and areal and vertical extent of the remaining vadose zone contaminant plume? Include contaminant isoconcentration maps and plume cross-sections to illustrate the contaminant concentrations and distribution in the subsurface.

B. Do the data indicate migration towards the groundwater? Qualitative answers to this question may be either "yes", "no" or "unable to make a determination". Evidence for migration towards groundwater may include such lines of evidence as: 1) increasing contaminant concentrations in

onsite monitoring wells; 2) pre-remediation soil gas profiles from nested wells to estimate the contaminant's propensity for migration; and 3) post-remediation time-series profiles of soil gas concentrations in nested wells.

C. What is the lithology of areas that do and do not demonstrate rebounds in soil gas concentration? Use site-specific information, and include as much information as possible, such as porosity, moisture content and carbon content of soil, etc.

D. What are the actual site-specific infiltration and percolation rates? If site-specific data are not available, what are the predicted rates?

E. Are there sufficient historical groundwater monitoring data for wells at or adjacent to the site to determine whether the vadose zone plume has or has not impacted the groundwater? (This determination may not be possible due to active groundwater extraction in the area.)

F. Are there any other site-specific factors that should be considered in the evaluation such as site history and physical characteristics (e.g. organic carbon, biodegradation)? Factors to consider for this element include: 1) the nature of the release (for example: one-time spill or continued release over time?; how long ago the release occurred or ceased?; was the release to surface soil, or through a conduit to the subsurface such as a French drain, dry well, or leaking sewer line?, etc.) and 2) any site-specific physical characteristics that may enhance or retard the contaminant's subsurface migration (such as unusual presence or absence of low permeability layers, high carbon content of soil, etc.).

G. What is the actual or predicted concentration and mass flux rate of leachate leaving the vadose zone? What is the concentration trend of leachate over time based on field data and modeling?

H. What was the mass removal rate prior to SVE shutdown?

I. What are the VOC concentration and cumulative mass removed expressed as a function of time?

J. How much money has been spent to date on the site's remediation?

K. Are further enhancements to the SVE systems predicted to be technically- or cost-effective?

L. What are the locations and capture zones of operating groundwater extraction wells relative to the vadose zone contaminant plume? Will the existing groundwater wells effectively (i.e., technically and economically) capture the COC contaminants from the site? If not, what are the additional costs to add groundwater extraction wells?

M. What is the incremental cost over time of continued vadose zone remediation compared to the incremental cost over time for additional groundwater remediation provided that the underlying contamination has not reached the aquifer clean-up level? In other words, will the residual mass in the vadose zone significantly prolong the time and increase the cost to attain the aquifer clean-up level?

To implement element "M", the following costs need to be calculated:

- The cost (GW_1) to reach the aquifer clean-up level *with* the additional impact from the site (assume SVE will not be continued);
- The cost (GW_2) to reach the aquifer clean-up level *with* the additional impact from the site after an additional period of SVE operation; and
- The cost (SVE_1) of the additional SVE operation.

These costs can be calculated following the steps outlined below:

1. Using the measured residual soil gas concentrations at the site, calculate the mass of the residual contaminant in the vadose zone (same as element "A").

2. Estimate the site's potential impact to groundwater using appropriate vadose zone and groundwater fate and transport models.

3. Estimate the time to reach the groundwater aquifer clean-up level using the modeling results obtained in step 2 above.

4. Estimate the monthly cost to continue operation of the groundwater extraction system in the area impacted by the site.

5. Calculate the cost to reach aquifer cleanup level *with* the additional impact from the site (GW_1), because SVE will not continue to be operated. (GW_1 = (step 3 x step 4) plus element L)

6. Estimate the monthly cost of continuing to operate the SVE system based on historical costs (including operation and shutdown periods for the site).

7. Estimate the cost to operate the SVE system for an agreed-upon additional length of time that is based on site-specific conditions, such as 6 months (SVE_1), by multiplying the agreed-upon length of time by the results of step 6. (SVE_1 = length of time x step 6).

8. Estimate what the predicted residual soil gas concentrations would be if the SVE system were operated for the additional agreed-upon length of time.

9. Estimate the impact to groundwater from the site based on the results of step 8. This estimation can be conducted similarly to step 2 above.

10. Estimate the predicted time required for groundwater extraction system to reach the aquifer clean-up level *with* the additional impact from the site assuming operation of the SVE system for the additional period of time agreed upon in step 7.

11. Calculate the cost to reach the aquifer clean-up level (GW_2) *with* the additional impact from the site assuming operation of the SVE system for an additional period of time. This cost is calculated by multiplying the results of step 10 by the results of step 4. (GW_2 = step 10 x step 4).

12. Compare the costs to reach the aquifer cleanup level *with* the additional impact from the site to the costs of continuing to operate a SVE system plus the cost to reach the aquifer cleanup level *with* the additional impact from the site after operation of the SVE system for an additional period of time. Mathematically this can be expressed as:

$$\text{Is } GW_1 > SVE_1 + GW_2 ?$$

If GW_1 is greater than (SVE_1 + GW_2), additional operation of the SVE system should be strongly considered.

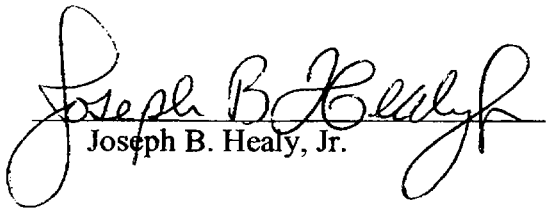
Implementation

The Air Force will operate the SVE system until it demonstrates that the cleanup goal set forth above has been met. The Air Force, the USEPA, and the State (DTSC and the RWQCB) will jointly decide based on the STOP evaluation whether the SVE system may be permanently shut off. The STOP should be implemented in a phased approach, with the less complex criteria (criteria I and II described above) being evaluated first. Evaluation of these two criteria may indicate that the SVE system can be shut off, without having to perform a complete STOP (criterion III).

There are several potential outcomes of the STOP evaluation. Ideally, the STOP would indicate that the SVE system could be permanently turned off, and all parties agree that the site could be closed. Another potential outcome is that the STOP would indicate that the SVE system could be permanently shut off, but that the site may not yet be suitable for closure, based on remaining threats to the environment or water quality. In this case, additional discussion between the parties is necessary to determine what course of action is warranted, such as alternate remedial measures or long-term monitoring. The STOP may also indicate that additional SVE is warranted at the site prior to permanent system shut off.

Due to the reliance of the STOP on professional judgment, another outcome of the STOP is that the parties may not agree on whether the SVE system can be shut off or not. If the parties cannot reach a joint resolution, any party may invoke dispute resolution.

US EPA: RPM



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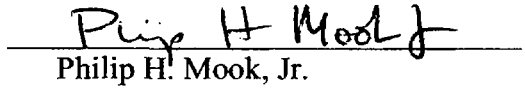
AFBCA: RPM

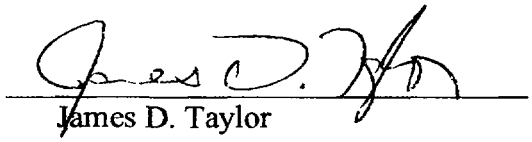


Philip H. Mook, Jr.

CA DTSC: RPM

Mark Malinowski

CVRWQCB: RPM



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ATTACHMENT 3

Index to the Administrative Record File

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Document Date	Subject or Title	Author / Corporate Affil	File Name
30 Apr 1981	RI, Final Report, Groundwater Contamination	2852 ABG/CEV	MCCLN_AR_30.pdf
01 Jul 1981	Records Search Report	CH2M HILL	MCCLN_AR_41.pdf
01 Sep 1981	Phase II, Problem Confirmation and Quantification Presurvey Report	Roy F. Weston, Inc.	MCCLN_AR_44.pdf
04 Mar 1982	Federal Register, National Revised Primary Drinking Water Regulations, Volatile Synthetic Organic Chemicals, Part IV, Vol. 47, No 43	HQ USEPA	MCCLN_AR_48.pdf
01 Jun 1983	Phase II, Final Confirmation Report, Vol. I of II	Engineering Science, Inc.	MCCLN_AR_58.pdf
01 Jun 1983	Phase II, Final Confirmation Report, Vol. II of II	Engineering Science, Inc.	MCCLN_AR_59.pdf
29 Nov 1983	Comptroller General Status Report, Air Force Efforts to Deal With Groundwater Contamination Problems	General Accounting Office	MCCLN_AR_236.pdf
01 Feb 1984	Sealing of Base Wells, Final Report	Luhdorff and Scalmanini Consulting Engineers	MCCLN_AR_297.pdf
01 Oct 1984	Phase III and IV, Site Characterization Study, Technical Memorandum No. 2, Shallow Exploration Program, OU-D	CH2M HILL	MCCLN_AR_461.pdf
09 Nov 1984	FS, Epidemiological Studies for Communities Near Base	Neutra, Raymond R.	MCCLN_AR_511.pdf
01 Mar 1985	Base Level Report, Site Characterization, OU-A, OU-B, OU-C, OU-D	McLaren Environmental Engineering	MCCLN_AR_570.pdf
19 Sep 1985	Hydrogeologic Assessment Report, Appendices, Vol. II	Idaho National Engineering Laboratory	MCCLN_AR_648.pdf
26 Sep 1985	LTM, Groundwater Monitoring Program Report, Surface Impoundments, OU-C1	McLaren Environmental Engineering	MCCLN_AR_650.pdf
01 Jan 1986	Technical Report No. 2, Monitoring/ Extraction System, OU-D	McLaren Environmental Engineering	MCCLN_AR_688.pdf
01 Feb 1986	Site Characterization Groundwater Report	McLaren Environmental Engineering	MCCLN_AR_703.pdf
01 Feb 1986	Technical Memorandum Report, Shallow Investigation Program, Part I, OU-A, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_704.1.pdf

Document Date	Subject or Title	Author / Corporate Affil	File Name
01 Feb 1986	Technical Memorandum Report, Shallow Investigation Program, Part I, OU-A, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_704.2.pdf
01 Feb 1986	Technical Memorandum Report, Shallow Investigation Program, Part II, OU-A, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_705.pdf
01 Feb 1986	Technical Memorandum Report, Shallow Investigation Program, Part III, OU-A, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_706.pdf
01 Apr 1986	Technical Memorandum Report, Shallow Investigation Program, Part IV, OU-A, OU-B	McLaren Environmental Engineering	MCCLN_AR_707.pdf
01 Apr 1986	Contamination Report, OU-A	McLaren Environmental Engineering	MCCLN_AR_721.pdf
01 Apr 1986	Site Characterization Groundwater Report	McLaren Environmental Engineering	MCCLN_AR_723.pdf
01 Apr 1986	FS, RA Plan, Source Control, OU-B	McLaren Environmental Engineering	MCCLN_AR_724.pdf
01 May 1986	Technical Memorandum Report, Shallow Investigation Program, Part V, Vol. I of III, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_708.pdf
01 May 1986	Technical Memorandum Report, Shallow Investigation Program, Part V, Appendix 1, Vol. II of III, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_709.1.pdf
01 May 1986	Technical Memorandum Report, Shallow Investigation Program, Part V, Appendix 1, Vol. II of III, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_709.2.pdf
01 May 1986	Technical Memorandum Report, Shallow Investigation Program, Part V, Appendices 2 and 3, Vol. III of III, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_710.1.pdf
01 May 1986	Technical Memorandum Report, Shallow Investigation Program, Part V, Appendices 2 and 3, Vol. III of III, OU-B, OU-C	McLaren Environmental Engineering	MCCLN_AR_710.2.pdf
01 May 1986	FS, RA Plan, Other Area Sites	McLaren Environmental Engineering	MCCLN_AR_733.pdf
01 May 1986	FS, RA Plan, Control Source, OU-A	McLaren Environmental Engineering	MCCLN_AR_734.pdf
01 Jun 1986	FS and RA Plan, Source Control, Area C	McLaren Environmental Engineering	MCCLN_AR_1009.pdf
01 Jun 1986	Report of Contamination, Area C	McLaren Environmental Engineering	MCCLN_AR_1010.pdf
01 Jul 1986	FS and RA Plan, Basewide Source Control	McLaren Environmental Engineering	MCCLN_AR_1017.pdf

Document Date	Subject or Title	Author / Corporate Affil	File Name
01 Nov 1986	Phase II, Stage 2-3, Final Confirmation/Quantification On-Base Monitoring Well Redevelopment Report	Radian Corp.	MCCLN_AR_1075.pdf
01 Dec 1986	Final Basewide Report on Contamination	McLaren Environmental Engineering	MCCLN_AR_1080.pdf
01 Dec 1986	FS, RA Plan, Final Basewide Source Control Report	McLaren Environmental Engineering	MCCLN_AR_1081.pdf
01 Apr 1987	Groundwater Treatment Facility Thirty-Day Performance Test Report, 17 Dec 86 to 15 Jan 87	Metcalf & Eddy	MCCLN_AR_1102.pdf
01 Jun 1987	Project Management Plan, Interim Extraction System, Area C	Idaho National Engineering Laboratory	MCCLN_AR_1119.pdf
01 Jul 1987	Evaluation of Technologies Report, Treat Soils Contaminated with Hazardous Waste	EG&G Idaho, Inc.	MCCLN_AR_1136.pdf
01 Dec 1987	Hydrogeologic Assessment Report, Surface Impoundments, Vol. I of III, Area C	EG&G Idaho, Inc.	MCCLN_AR_1217.pdf
01 Dec 1987	Hydrogeologic Assessment Report, Surface Impoundments, Vol. III of III, Area C	EG&G Idaho, Inc.	MCCLN_AR_1219.pdf
01 Feb 1988	Superfund Removal Procedures, Revision No. 3	HQ USEPA	MCCLN_AR_1213.pdf
01 Apr 1988	Hydrogeologic Assessment Revised Report, Surface Impoundments, Area C	EG&G Idaho, Inc.	MCCLN_AR_1241.pdf
01 Mar 1989	Stage 3, Final Report, Risk Assessment Protocol	Radian Corp.	MCCLN_AR_1355.pdf
01 Mar 1989	RI/FS, Stage 3, Groundwater Sampling and Analysis Program, Final Data Summary Report, Oct-Dec 88	Radian Corp.	MCCLN_AR_1356.pdf
01 Mar 1989	RI, Stage 3, Final Report, Background Sections	Radian Corp.	MCCLN_AR_1359.pdf
01 Jul 1989	Stage 5, AR Work Plan, Appendices	Radian Corp.	MCCLN_AR_1398.pdf
01 Jun 1990	Stage 5, Final AR Work Plan	Radian Corp.	MCCLN_AR_1533.pdf
29 Jun 1990	Groundwater Treatment System Report, Design Basis for Expedited Removal Action	Radian Corp.	MCCLN_AR_1547.pdf
01 Jul 1990	Soil Gas Investigation Work Plan, Sampling and Analysis, OU-B	Radian Corp.	MCCLN_AR_3494.pdf
01 Jan 1991	Stage 3, EE/CA Layperson's Summary, OU-B	Radian Corp.	MCCLN_AR_1631.pdf
01 Feb 1991	Stage 3, EA, EE/CA, Final Report, Disposal and Reuse, OU-B	Radian Corp.	MCCLN_AR_1654.1.pdf

Document Date	Subject or Title	Author / Corporate Affil	File Name
01 Feb 1991	Stage 3, EA, EE/CA, Final Report, Disposal and Reuse, OU-B	Radian Corp.	MCCLN_AR_1654.2.pdf
01 Mar 1991	Stage 7, Final AR 60-Day Evaluation Report	Radian Corp.	MCCLN_AR_1674.pdf
01 Apr 1991	Stage 3, Final Action Memorandum, OU-B	Radian Corp.	MCCLN_AR_1693.pdf
01 Apr 1991	Stage 3, FONSI, EE/CA, EA and Removal Action Final Report, Disposal and Reuse, OU-B	Radian Corp.	MCCLN_AR_1697.pdf
01 Sep 1991	ROD, RI/FS, Stage 7, No Further Action, OU-B	Radian Corp.	MCCLN_AR_765.pdf
01 Sep 1991	Final Data Summary Report, Apr-Jun 91	Radian Corp.	MCCLN_AR_1770.pdf
01 Oct 1991	PA, Stage 3, Summary Report, Vol. I of III, OU-B	Radian Corp.	MCCLN_AR_1793.1.pdf
01 Oct 1991	PA, Stage 3, Summary Report, Vol. I of III, OU-B	Radian Corp.	MCCLN_AR_1793.2.pdf
01 Oct 1991	PA, Stage 3, Summary Report, Vol. II of III, OU-B	Radian Corp.	MCCLN_AR_1794.pdf
01 Oct 1991	PA, Stage 3, Summary Report, Vol. III of III, OU-B	Radian Corp.	MCCLN_AR_1795.pdf
01 Nov 1991	RI, Stage 7, Final SAP, OU-B	Radian Corp.	MCCLN_AR_2989.pdf
01 Dec 1991	Stage 3, Agricultural Well Sampling Final Data Summary Report, Aug-Oct 91	Radian Corp.	MCCLN_AR_286.pdf
01 Dec 1991	Final SAP, Capehart Gas Station	CH2M HILL	MCCLN_AR_287.pdf
09 Dec 1991	Phase II, Final Technical Memorandum, Steam Injection/ Vapor Extraction, LF-022	CH2M HILL	MCCLN_AR_279.pdf
01 Jan 1992	Stage 3, Data Summary Report, Jul-Sep 91	Radian Corp.	MCCLN_AR_1688.pdf
01 Feb 1992	ROD, Final, Stage 3, No Further Action, OU-A	Radian Corp.	MCCLN_AR_1779.pdf
01 Feb 1992	SVE Treatability Investigation Report, Review of Emission Control Systems, DP-152	CH2M HILL	MCCLN_AR_1875.pdf
28 Feb 1992	FSP, Group 1, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_1880.pdf
01 Mar 1992	Site Grouping, Phasing Memorandum Report, OU-C1	Jacobs Engineering Group, Inc.	MCCLN_AR_1173.pdf
01 Apr 1992	Final Report, Steam Injection/Vacuum Extraction, Preliminary Feasibility Assessment and Cost Estimate, LF-022	CH2M HILL	MCCLN_AR_1891.pdf

Document Date	Subject or Title	Author / Corporate Affil	File Name
13 Apr 1992	FSP, Non Site Specific and Group 2	Jacobs Engineering Group, Inc.	MCCLN_AR_1897.pdf
14 Apr 1992	Final Site Characterization Technical Memorandum, SVE Treatability Investigation, DP-152	CH2M HILL	MCCLN_AR_1898.pdf
01 Sep 1992	RI, Final SAP, Vol. I, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_1883.pdf
01 Sep 1992	RI, Stage 7, Final Preliminary Groundwater OU Report, Appendix A, Vol. III of V	Jacobs Engineering Group, Inc.	MCCLN_AR_1948.1.pdf
01 Sep 1992	RI, Stage 7, Final Preliminary Groundwater OU Report, Appendix A, Vol. III of V	Jacobs Engineering Group, Inc.	MCCLN_AR_1948.2.pdf
01 Sep 1992	RI, Stage 7, Final Preliminary Groundwater OU Report, Appendices B, Part II, C, D, E, F, G, Vol. V of V	Jacobs Engineering Group, Inc.	MCCLN_AR_1949.pdf
01 Sep 1992	RI, Stage 7, Final Preliminary Groundwater OU Report, Vol. I of V	Radian Corp.	MCCLN_AR_2001.pdf
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01 Dec 1992	Management Action Plan (MAP)	Radian Corp.	MCCLN_AR_2048.pdf
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16 Feb 1993	Public Health Assessment Report	Agency for Toxic Substances and Disease Registry	MCCLN_AR_2083.pdf
15 Mar 1993	SI, Final Report, Capehart Service Station, ST-200	CH2M HILL	MCCLN_AR_2103.pdf
25 May 1993	Consensus Statement, Streamlining Remedial Decision Making	Slavich, Francis E., Capt./ Wang, Ming, Dr./ Moore, Katherine	MCCLN_AR_799.pdf
01 Jun 1993	RI/FS, Final Report, OU-B, OU-B1	Radian Corp.	MCCLN_AR_2135.pdf
01 Jun 1993	New Environmental Restoration Plan	Mitre Corp.	MCCLN_AR_2134.pdf
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01 Jul 1993	PA, Report, Vol. III of III, Appendix A1, OU-C	CH2M HILL	MCCLN_AR_2153.2.pdf
01 Jul 1993	Management Action Plan (MAP)	Mitre Corp.	MCCLN_AR_2157.pdf
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06 Aug 1993	ROD, NFA, PA Final, OU-D	CH2M HILL	MCCLN_AR_2180.pdf
01 Sep 1993	Technical Memorandum, Results of Soil Gas Permeability Testing, OU-B, IC-1, IC-7	Radian Corp.	MCCLN_AR_2192.pdf
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20 Oct 1993	Phase II, Phase III, ROD, Final Scoping Report, In Situ SVE Treatability Investigation	CH2M HILL	MCCLN_AR_2216.pdf
01 Nov 1993	Final Basewide EE/CA, SVE Report	Mitre Corp.	MCCLN_AR_2222.pdf
01 Nov 1993	EE/CA, Basewide SVE Responsiveness Summary	SM-ALC/EM	MCCLN_AR_2234.pdf
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31 Jan 1994	Removal Action Work Plan, SVE, Vol. I	URS Consultants Inc.	MCCLN_AR_3500.pdf
01 Feb 1994	Bioventing Pilot Test Work Plan and Draft Interim Results Report, Vol. I of II	Engineering Science, Inc.	MCCLN_AR_2251.pdf
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01 Jun 1994	RI, Final Report, Vol. I of III, OU-D	CH2M HILL	MCCLN_AR_2345.pdf
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01 Jun 1994	RI, Final Report, Vol. III of III, OU-D	CH2M HILL	MCCLN_AR_2347.pdf
01 Jun 1994	RI/FS, Final Report, Vol. I of III, Groundwater OU	CH2M HILL	MCCLN_AR_2348.pdf
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15 Jul 1994	Superfund Innovative Technology Evaluation, Public-Private Partnership Photolytic Destruction Demonstration Plan, DP-178	Science Applications International Corp.	MCCLN_AR_2379.pdf
19 Jul 1994	Final Superfund Innovative Technology Evaluation, Public-Private Partnership Two-Phase Extraction Demonstration Plan, SS-035, SS-045, WP-046	Science Applications International Corp.	MCCLN_AR_2381.pdf
02 Aug 1994	Groundwater OU Public Meeting Transcript on Proposed Cleanup Plan, 20 Jul 94	Shepard, Diane J.	MCCLN_AR_2383.pdf
01 Sep 1994	RI, Final Data Management Plan, OU-C	Radian Corp.	MCCLN_AR_2428.pdf
30 Sep 1994	EPA Letter to Base Concerning Information of General Interest Concerning Guidance and Interim ROD for Groundwater OU	Healy, Joseph B., Jr.	MCCLN_AR_2448.pdf
01 Oct 1994	Final Site Specific Removal Action Work Plan, SVE, IC-7	URS Consultants, Inc.	MCCLN_AR_2455.pdf
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01 Oct 1994	Final Basewide Removal Action Work Plan, SVE, Vol. II of II, Attachments	URS Consultants, Inc.	MCCLN_AR_2457.pdf
01 Oct 1994	Basewide Ecological Risk Assessment Final Scoping Report, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_2472.pdf
01 Nov 1994	RI, Interim Basewide Final Report, Part 1, General Framework	Radian Corp.	MCCLN_AR_2480.pdf
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01 Jan 1995	Historical Study 103, Confronting a Toxic Past, Chronology of Environmental Events and Issues	SM-ALC/Office of History	MCCLN_AR_2516.pdf
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01 Apr 1995	RI, Interim Basewide Final Report, Characterization Summaries, Appendix A, OU-C1	Jacobs Engineering Group, Inc.	MCCLN_AR_2603.3.pdf
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01 May 1995	SVE Systems Monthly Operations Report, Vol. I of II, IC-1, IC-7, OU-C1	URS Consultants, Inc.	MCCLN_AR_2640.pdf
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01 Jun 1995	ROD, Final Interim, Basewide Groundwater OU	CH2M HILL	MCCLN_AR_2657.pdf
01 Jul 1995	Final Report, Piping Network Expansion and SVE System Instructions, OU-B, IC-1, IC-7	Radian Corp.	MCCLN_AR_4315.pdf
12 Jul 1995	FS, Final Report, Basewide Vadose Zone	CH2M HILL	MCCLN_AR_2688.pdf
01 Aug 1995	Phase I, Final Work Plan, Vol. I of II, Groundwater OU	CH2M HILL	MCCLN_AR_2821.pdf
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01 Sep 1995	Phase I, Final Work Plan, IC-1, Groundwater OU	SM-ALC/EM	MCCLN_AR_2743.pdf
01 Nov 1995	RI, Interim Basewide Final Report, Site Characterization Summary and FSP, Part 2A, Vol. I of VI, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_2795.1.pdf
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01 Nov 1995	RI, Interim Basewide Final Report, Site Characterization Summary and FSP, Part 2C, Vol. I of III, OU-C	Radian Corp.	MCCLN_AR_2801.pdf
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09 Nov 1995	Removal Action Work Plan, SVE, Revision 5, Vol. I, IC-1, IC-7, IC-31, IC-23, Site S	URS Consultants, Inc.	MCCLN_AR_3519.pdf
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01 Dec 1995	Final FSP, Vadose Zone Model Validation, WP-092	Radian Corp.	MCCLN_AR_2841.pdf
13 Dec 1995	Multiple Decision Documents	CH2M HILL	MCCLN_AR_2843.pdf
15 Dec 1995	RI, Interim Basewide Final Report, General Framework, Appendices A through C, E, F, OU-B	Radian Corp.	MCCLN_AR_2855.pdf
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01 Jan 1996	Vadose Zone Monitoring Well Letter Report, Soil Gas Investigation, OU-D	CH2M HILL	MCCLN_AR_2868.pdf
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16 Jan 1996	Base Letter to CRWQCB Concerning Basis for Agreement for Groundwater and Vadose Zone Cleanup	Brunner, Paul G	MCCLN_AR_3012.pdf
26 Feb 1996	Final SVE, EE/CA, IC-31	Jacobs Engineering Group, Inc.	MCCLN_AR_3036.pdf
01 Mar 1996	Final Groundwater Treatability Study Work Plan, Liquid Phase Granular Activated Carbon, Alternative Technology 2	CH2M HILL	MCCLN_AR_3043.pdf
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01 Apr 1996	Vadose Zone Monitoring Well Letter Report, Soil Gas Investigation, OU-D	CH2M HILL	MCCLN_AR_3064.pdf
01 May 1996	Final Removal Action Work Plan, Basewide SVE	URS Consultants, Inc.	MCCLN_AR_3079.pdf
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01 Jun 1996	Final Work Implementation Plan, Current Operating Facility Assessment, Groundwater OU	CH2M HILL	MCCLN_AR_3094.pdf
01 Jun 1996	Final Removal Action Work Plan, SVE, IC-1, IC-7, Site-S	URS Consultants, Inc.	MCCLN_AR_3095.pdf
10 Jul 1996	Final Dual Phase Extraction Treatability Study Work Plan	Radian Corp.	MCCLN_AR_3120.pdf
01 Aug 1996	Final Removal Action Work Plan, SVE, IC-31	URS Consultants, Inc.	MCCLN_AR_3134.pdf
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01 Sep 1996	Final Treatability Study Report, Groundwater Treatment Plant	CH2M HILL	MCCLN_AR_3156.pdf
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01 Dec 1996	Final Modified System Performance Report, Current Operating Facility Assessment, Groundwater OU	CH2M HILL	MCCLN_AR_3214.pdf
01 Dec 1996	Risk Based Corrective Action Report, Diesel Generator	Geocon Environmental Consultants, Inc	MCCLN_AR_3539.pdf
29 Jan 1997	Final SVE, EE/CA, IC-19	Jacobs Engineering Group, Inc.	MCCLN_AR_3251.pdf
01 Feb 1997	Final Removal Action Work Plan, Addendum, IC-19	URS Consultants, Inc.	MCCLN_AR_3254.pdf
01 Mar 1997	Final Removal Action Work Plan, SVE, IC-19	URS Consultants, Inc.	MCCLN_AR_3285.pdf
01 Apr 1997	Final Removal Action Work Plan, SVE, IC-23	URS Consultants, Inc.	MCCLN_AR_3307.pdf
01 Apr 1997	Final FSP, OU-E, OU-F, OU-G, OU-H	Radian Corp.	MCCLN_AR_3313.1.pdf
01 Apr 1997	Final FSP, OU-E, OU-F, OU-G, OU-H	Radian Corp.	MCCLN_AR_3313.2.pdf
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16 May 1997	Technical Memorandum, Natural Attenuation Study Report, IC-19	Radian Corp.	MCCLN_AR_3343.pdf
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01 Jun 1997	RI, Final Interim Basewide Report, Part 1, Vol. I of II, Revision 1	Radian Corp.	MCCLN_AR_3355.pdf
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17 Jun 1997	RA, Phase Id, Implementation Report, Groundwater OU	Radian Corp.	MCCLN_AR_3364.pdf
26 Jun 1997	Field Demonstration Work Plan, Bioremediation Treatment Technology Demonstration of SVE Off Gas	Battelle	MCCLN_AR_3371.pdf
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01 Jul 1997	Final Supplemental Environmental Baseline Survey (EBS), Vol. I of II	Radian Corp.	MCCLN_AR_3549.pdf
01 Jul 1997	Final EIS, Disposal and Reuse, Vol. I of II	SM-ALC/EMR	MCCLN_AR_4029.pdf
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31 Jul 1997	Technical Memorandum, Demonstration of Screening Survey, IC-19	SM-ALC/EMR	MCCLN_AR_3419.pdf
01 Aug 1997	RI, Final Interim Basewide Report, Characterization Summary, FSP, Part 2c, Vol. I of IV, OU-C	Radian Corp.	MCCLN_AR_3404.pdf
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01 Sep 1997	Final Removal Action Work Plan, SVE, Addendum, IC-29	URS Greiner, Inc.	MCCLN_AR_3439.pdf
01 Sep 1997	SERDP Technology Demonstration Application Analysis Report, Titanium Dioxide Photocatalytic Vapor Treatment System	URS Greiner, Inc.	MCCLN_AR_3440.pdf
02 Sep 1997	Work Implementation Plan, Recirculating Wells as a Hydraulic Control and Oxygen Delivery System for Aerobic Co-Metabolism of Chlorinated Solvents	EG&G Environmental, Inc.	MCCLN_AR_3441.pdf
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09 Oct 1997	Technology Demonstration Work Plan, Determining the Effectiveness of a Fluid Bed Bioreactor System	Envirogen, Inc.	MCCLN_AR_3463.pdf
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01 Nov 1997	Technology Application Analysis Report, SVE, Catalytic Oxidation, Acid Scrubbing, OU-C1	URS Greiner, Inc.	MCCLN_AR_3478.pdf
01 Dec 1997	Final Supplemental Environmental Baseline Survey (EBS), Bldg. Survey Addendum	Radian Corp.	MCCLN_AR_3561.pdf
03 Dec 1997	Base Action Memorandum, EE/CA, SVE, IC-29	Anderson, Elaine S	MCCLN_AR_2018.pdf
01 Jan 1998	Final FSP, IC-27, IC-35	URS Greiner, Inc.	MCCLN_AR_756.pdf
01 Jan 1998	RI, Final Interim Basewide Report, Characterization Summary, Part 2c, Vol. I of III, IC-17, IC-19, IC-21	Radian Corp.	MCCLN_AR_2452.pdf
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01 Jan 1998	Removal Action Report, SVE, IC-29	URS Greiner, Inc.	MCCLN_AR_762.pdf
05 Jan 1998	Annual Report, Data Analysis for Preliminary Conceptual Model Design, Vadose Zone Monitoring System, 97	Ernest Orlando Lawrence Berkeley National Laboratory	MCCLN_AR_4034.pdf
01 Feb 1998	Final SAP, Support to Recommendation for No Further Investigation, SS-184	Parsons Engineering Science, Inc.	MCCLN_AR_1717.pdf
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01 Mar 1998	Phase II, RD, Final SAP, Groundwater OU	CH2M HILL	MCCLN_AR_272.pdf
25 Mar 1998	Technology Demonstration Work Plan, Subsurface Remediation	Surbec Environmental, Inc.	MCCLN_AR_811.pdf
01 Apr 1998	Final Basewide Removal Action Work Plan, SVE	URS Greiner, Inc.	MCCLN_AR_823.pdf
01 May 1998	Final, EE/CA, SVE, ST-150	URS Greiner, Inc.	MCCLN_AR_851.pdf
01 Jun 1998	Final Groundwater Monitoring Program Quarterly Report, First Quarter 98	Radian Corp.	MCCLN_AR_868.pdf
19 Jun 1998	Technology Analysis Report, PRDA Test, Fluidized Bed Adsorption, IC-31	Harding Lawson Associates	MCCLN_AR_873.pdf
01 Jun 1998	Final Groundwater Monitoring Program Quarterly Report, First Quarter 98	Radian Corp.	MCCLN_AR_868.pdf
24 Jun 1998	EE/CA, SVE Action Memorandum, ST-150	SM-ALC/EMR	MCCLN_AR_884.pdf
25 Jun 1998	EE/CA, SVE Action Memorandum, IC-35	SM-ALC/EMR	MCCLN_AR_885.pdf
25 Jun 1998	EE/CA, SVE Action Memorandum, IC-27	SM-ALC/EMR	MCCLN_AR_886.pdf
01 Jul 1998	Final Work Implementation Plan, Catalytic Ozonation of Contaminated Groundwater	URS Greiner, Inc.	MCCLN_AR_925.pdf
16 Jul 1998	FS, ROD Development Agreement	Anderegg, Elaine S./ Adams, Randy S./ Healy, Joseph B., Jr./ MacDonald, Alexander M.	MCCLN_AR_1866.pdf
20 Jul 1998	Technology Demonstration Work Plan, Dual Anaerobic/Aerobic Fluidized Bed Bioreactor Biofilm Process	Envirogen, Inc.	MCCLN_AR_4035.pdf
01 Aug 1998	Final Technology Demonstration Work Plan, Surfactant, Cosolvent Enhanced Subsurface Remediation of Dense Nonaqueous Phase Liquids	Surbec Environmental, Inc.	MCCLN_AR_893.pdf
01 Aug 1998	Final Data Gap FSP 1	Radian Corp.	MCCLN_AR_894.1.pdf
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01 Sep 1998	Final Groundwater Monitoring Program Quarterly Report, Second Quarter 98	Radian Corp.	MCCLN_AR_897.pdf

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01 Sep 1998	Final Data Gap FSP 2	Radian Corp.	MCCLN_AR_898.4.pdf
01 Sep 1998	Technology Application Analysis Report, SVE with Flameless Oxidation, Acid Scrubbing, IC-23	URS Greiner, Inc.	MCCLN_AR_954.pdf
28 Sep 1998	EPA Letter to Base Concerning Acceptance of Phase I RA Report, Groundwater OU	Opalski, Daniel D	MCCLN_AR_920.pdf
01 Oct 1998	Final Site Characterization, FSP, Vol. I of IV, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_899.1.pdf
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01 Oct 1998	Final Site Characterization Summary, FSP, Vol. II of IV, Appendix A, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_900.1.pdf
01 Oct 1998	Final Site Characterization Summary, FSP, Vol. II of IV, Appendix A, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_900.2.pdf
01 Oct 1998	Final Site Characterization Summary, FSP, Vol. III of IV, Appendix B, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_901.pdf
01 Oct 1998	Final Site Characterization Summary, FSP, Vol. IV of IV, Appendix C, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_902.pdf
01 Oct 1998	RI, Final Interim Basewide Report, Characterization Summary, Parts 2e-2h, Vol. I of V, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_903.pdf
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01 Oct 1998	RI, Final Interim Basewide Report, Characterization Summary, Parts 2e-2h, Vol. II of V, Appendix A, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_904.2.pdf
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01 Nov 1998	Final Data Gap FSP, Magpie Creek, Don Julio Creek	Radian Corp.	MCCLN_AR_910.pdf
06 Nov 1998	Performance Monitoring Plan, Cometabolic Air Sparging, Groundwater OU	Battelle	MCCLN_AR_3583.pdf
01 Dec 1998	Final Work Implementation Plan, Microwave Regeneration of Granular Activated Carbon for Vapor Phase Treatment of VOC	Metcalf &Eddy	MCCLN_AR_911.pdf
01 Dec 1998	Final FSP, Addendum, OU-E, OU-F, SS-095, SD-264	Jacobs Engineering Group, Inc.	MCCLN_AR_926.pdf
01 Dec 1998	Final Basewide SVE Report, Well Installation FSP	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_2872.pdf
18 Dec 1998	Final Technology Demonstration Application Analysis Report, Determining the Effectiveness of a Fluidized Bed Bioreactor System	Envirogen, Inc.	MCCLN_AR_912.pdf
01 Jan 1999	Final Groundwater Monitoring Program Quarterly Report, Third Quarter 98	Radian Corp.	MCCLN_AR_914.pdf
01 Jan 1999	Final Data Gap FSP, Northwest Taxiway and Dudley Blvd	Radian Corp.	MCCLN_AR_927.pdf
01 Jan 1999	Passive SVE Technology Demonstration, Final Work Implementation Plan	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_2873.pdf
01 Mar 1999	Update Pages, Final Basewide Data Gap, FSP 3	Jacobs Engineering Group, Inc.	MCCLN_AR_929.pdf
01 Mar 1999	Final, EE/CA, SVE, IC-30	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_948.pdf
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01 Apr 1999	Final BRAC Cleanup Plan (BCP)	Radian Corp.	MCCLN_AR_918.pdf
01 Apr 1999	Technical Memorandum, Basis of Evaluation EE/CA, SVE	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_940.pdf
01 Apr 1999	Final Groundwater Monitoring Program Quarterly Report, Fourth Quarter 98	Radian Corp.	MCCLN_AR_4321.pdf
27 Apr 1999	CDTSC Letter to Base Concerning Approval of Five Year Review and Protectiveness Determination	Ward, Daniel T.	MCCLN_AR_2891.pdf
10 May 1999	First Progress Report, Surfactant/Cosolvent Enhances Subsurface Remediation of Dense Nonaqueous Phase Liquids	Surbec Environmental, Inc.	MCCLN_AR_2876.pdf
17 May 1999	Final Action Memorandum for SVE, IC-30	SM-ALC/EMR	MCCLN_AR_2926.pdf
28 May 1999	Data Gap Field Sampling and SVE Well Installation, Data Quality Assessment Report	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_2878.pdf
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01 Jun 1999	Final EE/CA, SVE, IC-32	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_2881.pdf
01 Jun 1999	Final EE/CA, SVE, IC-37	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_2882.pdf
01 Jun 1999	First Quarter 99 Final Report, Groundwater Monitoring Program, OU-D	Radian Corp.	MCCLN_AR_2883.pdf
01 Jun 1999	Final EE/CA, SVE, IC-34, OU-A	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_2884.pdf
01 Jun 1999	Final Work Implementation Plan, Passive Diffusion Membrane Samplers	SM-ALC/EMR	MCCLN_AR_3618.pdf
15 Jun 1999	Semi-Annual Report, VOC Transport Modeling for Vadose Zone Monitoring System, WP-092	Lawrence Berkeley National Laboratory	MCCLN_AR_946.pdf
01 Jul 1999	SVE Removal Action Report, IC-27	Radian Corp.	MCCLN_AR_2931.pdf
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01 Sep 1999	Final EE/CA, CS-10, PRL-032	Radian Corp.	MCCLN_AR_2919.pdf
01 Sep 1999	Final Data Gap FSP 4	Radian Corp.	MCCLN_AR_2920.pdf
01 Sep 1999	Final Report, Vadose Zone Monitoring System, S-7	Lawrence Berkeley National Laboratory	MCCLN_AR_3659.pdf
01 Sep 1999	Final Report, Dual Anaerobic/Aerobic Fluidized Bed Bioreactor Biofilm Process, Vol. II of II	Envirogen, Inc.	MCCLN_AR_4041.pdf
01 Oct 1999	Final Groundwater Monitoring Program Quarterly Report, Second Quarter 99	Radian Corp.	MCCLN_AR_3680.pdf
01 Oct 1999	Final EE/CA, SVE Report, IC-25	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_3681.pdf
01 Oct 1999	Final EE/CA, SVE Report, IC-43	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_3682.pdf
01 Oct 1999	Final EE/CA, SVE Report, IC-5	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_3683.pdf
01 Oct 1999	Final EE/CA, SVE Report, SSA 2	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_3684.pdf
01 Oct 1999	Final EE/CA for SVE Report, PRL 66	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_3685.pdf
01 Oct 1999	Final EE/CA for SVE Report, PRL S-13	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_3686.pdf
19 Oct 1999	Final SVE Action Memorandum, IC-32	SM-ALC/EMR	MCCLN_AR_3695.pdf
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20 Oct 1999	Final SVE Action Memorandum, IC-42	SM-ALC/EMR	MCCLN_AR_3700.pdf
25 Oct 1999	Final Five Year Review Report, Groundwater, OU-B, OU-B1	Radian Corp.	MCCLN_AR_3705.pdf
01 Dec 1999	FS, Report, Final Basewide VOC, Vol. I of III	CH2M HILL	MCCLN_AR_3721.pdf
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01 Jan 2000	FS, Report, Final Basewide VOC	CH2M HILL	MCCLN_AR_3742.pdf
01 Jan 2000	Final EE/CA, Staging Pile Technical Memorandum, Non-VOC	CH2M HILL	MCCLN_AR_3744.pdf
01 Feb 2000	Final Work Plan, Remedial Process Optimization Evaluation, OU-D	Parsons Engineering Science, Inc.	MCCLN_AR_4050.pdf
29 Feb 2000	Technical Memorandum Report, SVE Strategy	Mitretek Systems	MCCLN_AR_3771.pdf
01 Mar 2000	Final Removal Action Work Plan, Design Document, IC-30, IC-32	CET Environmental Services, Inc	MCCLN_AR_3773.pdf
01 Mar 2000	Final Supplemental Environmental Baseline Survey (EBS), Facilities and Associated Properties, Group 2	Radian Corp.	MCCLN_AR_3774.pdf
13 Mar 2000	Final Action Memorandum, SVE, IC-5	SM-ALC/EMR	MCCLN_AR_3783.pdf
13 Mar 2000	Final Action Memorandum, SVE, SSA-2	SM-ALC/EMR	MCCLN_AR_3784.pdf
13 Mar 2000	Final Action Memorandum, SVE, PRL S-13	SM-ALC/EMR	MCCLN_AR_3785.pdf
13 Mar 2000	Final Action Memorandum, SVE, IC-43	SM-ALC/EMR	MCCLN_AR_3786.pdf
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01 Apr 2000	Final Groundwater Monitoring Report, Fourth Quarter 99	Radian Corp.	MCCLN_AR_3800.pdf
01 Apr 2000	RI, Final Report, Addenda, Vol. I of V, OU-D	Radian Corp.	MCCLN_AR_3801.pdf
01 Apr 2000	Update Pages, RI Final Report, Addenda, Vol. II of V, OU-D	Radian Corp.	MCCLN_AR_3802.pdf
01 Apr 2000	Update Pages, RI Final Report, Addenda, Vol. III of V, OU-D	Radian Corp.	MCCLN_AR_3803.pdf
01 Apr 2000	RI, Final Report, Addenda, Vol. IV of V, Appendices A-C, OU-D	Radian Corp.	MCCLN_AR_3804.pdf
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24 Apr 2000	CDTSC Letter to Base Concerning Initiation of Dispute on IAG, Proposed Plan, VOC	Landis, Anthony J.	MCCLN_AR_3817.pdf
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01 May 2000	Final Work Implementation Plan, OU-B	Radian Corp.	MCCLN_AR_3823.pdf
01 May 2000	Final Supplemental Environmental Baseline Survey (EBS), Group 3	Radian Corp.	MCCLN_AR_3824.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. I of VIII, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3837.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. II of VIII, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3838.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. III of VIII, Appendix A, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3839.1.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. III of VIII, Appendix A, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3839.2.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. IV of VIII, Appendix A, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3840.1.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. IV of VIII, Appendix A, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3840.2.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. V of VIII, Appendix B, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3841.1.pdf
01 Jun 2000	RI, Final Basewide Report, Characterization Summaries 2, Parts 2E-2H, Vol. V of VIII, Appendix B, OU-E, OU-F, OU-G, OU-H	Jacobs Engineering Group, Inc.	MCCLN_AR_3841.2.pdf
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01 Oct 2000	Removal Action Report, SVE, IC-34, IC-37	Radian Corp.	MCCLN_AR_3926.pdf
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02 Nov 2000	CRWQCB Memo Concerning Establishing Numerical Water Quality Limits, Cleanup of Groundwater	Marshack, Jon B.	MCCLN_AR_4207.pdf
07 Nov 2000	Decision Document, Action Memorandum, CS-10	Lowas, Albert F., Jr.	MCCLN_AR_4078.pdf
01 Dec 2000	RA, Work Plan, Final Design Document, PRL 66B	Cape Environmental Management, Inc.	MCCLN_AR_4330.pdf
01 Dec 2000	Final Supplemental Environmental Baseline Survey (EBS), Vol. I of II, Group 6	URS Greiner Woodward Clyde, Inc.	MCCLN_AR_3963.pdf
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01 Feb 2001	Final Work Implementation Plan, Ex Situ Wet Oxidation Treatability Study, Revision 0	URS Corp.	MCCLN_AR_4121.pdf
01 Mar 2001	Final FSP, Radiological Investigation, Revision 0, Unincorporated Area	Cabrera Services, Inc.	MCCLN_AR_4141.pdf
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01 Apr 2001	Final Groundwater Monitoring Program, Quarterly Report, Fourth Quarter 00	URS Group, Inc.	MCCLN_AR_4145.pdf
01 Apr 2001	RA, Final Design Work Plan, PRL S-13, SS-098	Cape Environmental Management, Inc.	MCCLN_AR_4167.pdf
01 Apr 2001	RA, Final, Design Document Work Plan, Risk Assessment, SSA-2, SS-300	Cape Environmental Management, Inc.	MCCLN_AR_4168.pdf
01 Jun 2001	RI, Final Interim Basewide Report, Characterization Summaries and Addenda, Part 2C1, Vol. I of III, OU-C1	URS Corp.	MCCLN_AR_4193.pdf
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01 Jun 2001	RI, Final Interim Basewide Report, Characterization Summaries and Addenda, Part 2C1, Appendices A, B, C, E, F, G, Vol. II of III, OU-C1	URS Corp.	MCCLN_AR_4194.2.pdf
01 Jun 2001	RI, Final Interim Basewide Report, Characterization Summaries and Addenda, Part 2C1, Appendix D, Vol. III of III, OU-C1	URS Corp.	MCCLN_AR_4195.pdf
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01 Aug 2001	RI, Interim Basewide Report, Technical Memorandum, Appendices I, II, III-1, Vol. I of III, Bldg 252, PRL S-18, SD-103	Jacobs Engineering Group, Inc.	MCCLN_AR_4233.pdf
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01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. I of XIV, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4262.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. II of XIV, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4263.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. III of XIV, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4264.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. IV of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4265.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. IV of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4265.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. V of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4266.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. V of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4266.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. VI of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4267.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. VI of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4267.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. VII of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4268.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. VII of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4268.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. VIII of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4269.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. VIII of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4269.2.pdf

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01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. IX of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4270.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. IX of XIV, Appendix A, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4270.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. X of XIV, Appendix B, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4271.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. X of XIV, Appendix B, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4271.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. XI of XIV, Appendix C1-C10, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4272.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. XI of XIV, Appendix C1-C10, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4272.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. XI of XIV, Appendix C1-C10, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4272.3.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. XII of XIV, Appendix D1-D4, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4273.1.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. XII of XIV, Appendix D1-D4, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4273.2.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. XIII of XIV, Appendix D4-D6, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4274.pdf
01 Sep 2001	RI, Final Interim Basewide Characterization Summaries Report, Part 2A, Vol. XIV of XIV, Appendix D6-D7, OU-A	Jacobs Engineering Group, Inc.	MCCLN_AR_4275.pdf
01 Oct 2001	Removal Action Report, SVE, OU-B, PRL S-13, SS-098	Cape Environmental Management, Inc.	MCCLN_AR_4292.pdf
01 Oct 2001	Final, Basewide Removal Action Work Plan, SVE	URSG-Laidlaw	MCCLN_AR_4293.pdf

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01 Nov 2001	Removal Action Report, OU-B, SSA-2, SS-300	Cape Environmental Management, Inc.	MCCLN_AR_4309.pdf
05 Dec 2001	Resolution of Formal Dispute on the Proposed Plan for the VOC Operable Unit, McClellan Air Force Base	Keith Takata/EPA Region 9	MCCLN_AR_4688.pdf
01 Jan 2002	Final Radiological FSP, Groundwater Monitoring Program	URS Corp.	MCCLN_AR_4367.pdf
01 Jan 2002	Final Groundwater Monitoring Program FSP, Extraction Well Sampling Event	URS Corp.	MCCLN_AR_4365.pdf
01 Feb 2002	Removal Action, Vadose Zone Quarterly Monitoring Report, SVE	URSG-OHM	MCCLN_AR_4379.pdf
01 Mar 2002	Final Technology Application Analysis Report, Surfactant/ Cosolvent Enhanced Subsurface Remediation of DNAPL	AFBCA/DM McClellan	MCCLN_AR_4395.pdf
12 Apr 2002	Final Investigation Work Plan, Capehart Gas Station, Bldg 5365	Brown and Caldwell	MCCLN_AR_4431.pdf
18 Apr 2002	Phase III, VOC Data Gaps FSP, Groundwater OU	CH2M HILL	MCCLN_AR_4418.pdf
01 May 2002	Removal Action, SVE Quarterly Monitoring Report and Closure Considerations, First Quarter 02	URS Corp.	MCCLN_AR_4447.pdf
09 May 2002	Phase III, Final Work Plan, Groundwater OU	CH2M HILL	MCCLN_AR_4463.pdf
29 May 2002	Phase I-VI, Final Well Decommissioning Program Summary Report	CH2M HILL	MCCLN_AR_4470.pdf
01 Jun 2002	Final FSP, Trace Metal Clean Sampling Event, Groundwater Treatment Plant	URS Group, Inc.	MCCLN_AR_4473.pdf
01 Jun 2002	Final FSP, Trace Metal Clean Sampling Event, Groundwater Treatment Plant	URS Group, Inc.	MCCLN_AR_4473.pdf
01 Jun 2002	Fact Sheet, Environmental Action Update, As Tenants Move In, Air Force Moves to Ensure Health and Safety, Apr 02-Jun 02	AFBCA/DM McClellan	MCCLN_AR_4474.pdf
01 Jun 2002	Fact Sheet Groundwater Air Force Base Conservation Agency, McClellan No. 2-02 June 2002	Young, Dawn / Fowler, Diane / Cooper, David	MCCLN_AR_4699.pdf
01 Jun 2002	Fact Sheet Soil Vapor Extraction Air Force Base Conversion Agency, McClellan No. 2 -03	Young, Dawn / Fowler, Diane / Cooper, David	MCCLN_AR_4700.pdf
01 Jun 2002	Fact Sheet Radon in Soil Vapor Extraction Systems Air Force Base Conversion Agency, McClellan No. 2 - 04	Young, Dawn / Fowler, Diane / Cooper, David	MCCLN_AR_4701.pdf

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19 Jun 2002	McClellan Air Force Base Operable Unit A Remedial Investigation Characterization Summaries Addendum	Jacobs Engineering	MCCLN_AR_4970.1.pdf
19 Jun 2002	McClellan Air Force Base Operable Unit A Remedial Investigation Characterization Summaries Addendum	Jacobs Engineering	MCCLN_AR_4970.pdf
19 Jun 2002	McClellan CERCLA Decisions, i.e., Cumulative Risk and ROD Cleanup Levels	Brunner, Paul G.	MCCLN_AR_5621.pdf
01 Jul 2002	IC 19 Thermal Oxidizer SVE System Design Addendum	Graff, Paul	MCCLN_AR_4727.pdf
01 Sep 2002	Addendum to the Groundwater Monitoring Program Field Sampling Plan for 1 ,4-Dioxane, Hexavalent Chromium, and Total Metals in Groundwater Monitoring and Extraction Wells	Smarkel, Ken / Callen, Brenda	MCCLN_AR_4759.pdf
24 Sep 2002	IRP Site Base Well 18 (WIMS: CG066)	Brunner, Paul G.	MCCLN_AR_4780.pdf
24 Sep 2002	IRP Sites/(WIMS #): CS 001 (LFOO1), CS 002 (LFOO2), CS 003 (LFOO3), CS 004 (DPOO4), CS 005 (DP005), CS 006 (DPOO6), CS 026 (LF026), PRL 027 (DP027), CS A (DP151), CS S (DP152), CS T(DP153), and Vadose Zone Site (DP178)	Brunner, Paul G.	MCCLN_AR_4784.pdf
24 Sep 2002	IRP Site Off-Base Wells, Raley Blvd. (WIMS #: CG067)	Brunner, Paul G.	MCCLN_AR_4777.pdf
28 Oct 2002	Contract F04699-99-D-0013, Task Order No. 9001 Soil Vapor Extraction (SVE) Remedial Action Operation (RA-O) and Site Closeout/Delisting at (the former) McClellan AFB SVE Lifecycle Analysis	Graff, Paul	MCCLN_AR_4790.pdf
29 Oct 2002	Former McClellan Air Force Base Installation Restoration Program Groundwater Monitoring Program Quarterly Report Second Quarter 2002	Callen, Brenda / Smarkel, Ken	MCCLN_AR_5213.pdf
05 Dec 2002	United States Department of the Air Force, Former McClellan Air Force Base (AFB), Groundwater Extraction and Treatment System, Sacramento County—Report of Inspection	Russell, John S.	MCCLN_AR_4855.pdf
11 Dec 2002	Soil Vapor Extraction Operation and Maintenance IC 19 Thermal Oxidizer SVE System Design Addendum McClellan AFB IC 19 Design Addendum, Final Copy, DSR# 794-3	Brunner, Paul G.	MCCLN_AR_4853.pdf
01 Jan 2003	Groundwater Treatment Facilities Operation and Maintenance Evaluation of Treatment Alternatives	Callen, Brenda	MCCLN_AR_4500.pdf

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01 Jan 2003	January-March 2003 Environmental Action Update, A Quarterly Newsletter about Environmental Activities at McClellan	Brunner, Paul G.	MCCLN_AR_4539.pdf
10 Jan 2003	Final GWOU Phase III Sampling and Analysis Plan (SAP)	CH2M HILL	MCCLN_AR_4991.pdf
14 Jan 2003	United States Department of the Air Force, Former McClellan Air Force Base (AFB), Groundwater Extraction and Treatment System, Sacramento County Re-Notice of Public Hearing, Change in Date	Russell, John S.	MCCLN_AR_4499.pdf
12 Feb 2003	Groundwater Monitoring Program Electronic Submittal of Final Quarterly Report, First Quarter 2002 McClellan Air Force Base F04699-99-D-001319002, PRJY 2002-725 1	Callen, Brenda / Smarkel, Ken	MCCLN_AR_4527.pdf
26 Feb 2003	Requirement to Submit Monitoring Data for the Groundwater Treatment Plant Effluent	Brunner, Paul G	MCCLN_AR_5584.pdf
27 Mar 2003	Hexavalent Chromium Tine Critical Removal Action at the former McClellan AFB Groundwater Treatment Plant	Hale, Jacqueline	MCCLN_AR_4566.pdf
01 Apr 2003	Environmental Action Update, A Quarterly Newsletter About Environmental Activities At McClellan	Young, Dawn	MCCLN_AR_4933.pdf
10 Apr 2003	Final Bioventing Vapor Monitoring Point Report For Five Sites(DSR# 856-1), Former McClellan Air Force Base (AFB) Sacramento County	Taylor, James D.	MCCLN_AR_4629.pdf
22 Apr 2003	IRP Site Base Well 18 (WIMS #: CG066)	Brunner, Paul G.	MCCLN_AR_4592.pdf
23 Apr 2003	Final Change Pages to the Groundwater Monitoring Plan (GWMP)	Brunner, Paul G.	MCCLN_AR_4594.pdf
24 Apr 2003	SUBJECT: Documentation for Groundwater Monitoring Wells Installed by Jacobs in 2001 (DSR# 909)	Brunner, Paul G.	MCCLN_AR_4572.pdf
24 Apr 2003	Documentation for Groundwater Monitoring Wells Installed by Jacobs in 2001 (DSR# 909)	Brunner, Paul G.	MCCLN_AR_4596.pdf
01 May 2003	FINAL Bioventing Installation Work Plan for Site B/756 (PRL T-48)	Parsons	MCCLN_AR_4620.pdf
01 May 2003	Soil Vapor Extraction Removal Action Quarterly Vadose Zone Monitoring Report for January through March 2003	URS	MCCLN_AR_4952.pdf

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02 May 2003	Notice of Adoption Waste Discharge Requirements For United States Department of The Air Force Former McClellan Air Force Base Ground Water Extraction and Treatment System (GWTS) Sacramento County	Russell, John S.	MCCLN_AR_4606.pdf
17 May 2003	Submittal of Groundwater Monitoring Program, Quarterly Report, Fourth Quarter 2001, F41624-97-D-8020-0137	Callen, Brenda / Benedict, Stephanie	MCCLN_AR_4936.pdf
22 May 2003	Final Field Sampling Plan (FSP) for BW-10 Guard Well, DSR# 798-3	Brunner, Paul	MCCLN_AR_4929.pdf
05 Jun 2003	Final Technical Memorandum Off Base GWOU Phase III VOC Data Gaps Investigation	MWH	MCCLN_AR_4983.pdf
06 Jun 2003	Groundwater Treatment Facilities Operation and Maintenance Life Cycle Analysis	Callen, Brenda / Benedict, Stephanie	MCCLN_AR_4610.pdf
18 Jun 2003	McClellan Airfield; Groundwater Monitoring Well Site 3; 2003-AWP-274-NRA	Rodriguez, Joseph R.	MCCLN_AR_4901.pdf
18 Jun 2003	McClellan Airfield; Groundwater Monitoring Well Site 1; 2003-AWP-272-NRA	Rodriguez, Joseph R.	MCCLN_AR_4915.pdf
24 Jun 2003	Quarterly Inspection Report, Operable Unit (OU) D Cap	Brunner, Paul G.	MCCLN_AR_4660.pdf
16 Jul 2003	Revised Final Bioventing Vapor Monitoring Point Report for Five Sites (DSR# 856-1)	Brunner, Paul	MCCLN_AR_4944.pdf
27 Jul 2003	Former McClellan Air Force Base Installation Restoration Program Groundwater Monitoring Program Quarterly Report First Quarter 2003	Callen, Brenda / Benedict, Stephanie	MCCLN_AR_5484.pdf
26 Aug 2003	Groundwater Monitoring Program Electronic Submittal of Final Quarterly Report, First Quarter 2003 McClellan Air Force Base F04699-99-D-0013/9002 PRJY 2002-725 1	Callen, Brenda / Benedict, Stephanie K.	MCCLN_AR_4890.pdf
15 Sept 2003	Basewide Quality Assurance Project Plan. Revision 5. Final.	URS Group	MCCLN_AR_4945.pdf
23 Sep 2003	Data Gap 38 Aquifer Test Performed at EW-302—Submittal of Raw Data F04699-99-D-0013/9002, PRJY 2003-7251	Willmeth, Elise / Benedict, Stephanie	MCCLN_AR_4930.pdf
23 Sep 2003	McClellan Groundwater Issue: Hotspot Treatment Technologies Prepared for the Air Force Real Property Agency, Division D, McClellan	Sextro, R.K.	MCCLN_AR_5044.pdf

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29 Sep 2003	Baseline Groundwater Sampling of On-base Phase III Data Gap Wells Data Transfer, F04699-99-D-00 13/9002, PRJY 2003-7251	Callen, Brenda / Benedict, Stephanie	MCCLN_AR_4870.pdf
01 Oct 2003	2003 Base Realignment and Closure Cleanup Plan	URS Group	MCCLN_AR_4949.pdf
01 Oct 2003	Environmental Action Update, July-September 2003	Brunner, Paul G.	MCCLN_AR_5277.pdf
07 Oct 2003	Data Gap 34 Aquifer Test Performed at EW-333—Submittal of Raw Data F04699-99-D-0013/9002, PRJY 2003-7251	Southard, Rosa	MCCLN_AR_5045.pdf
08 Oct 2003	Data Gap 21 Aquifer Test Performed at MW-403—Submittal of Raw Data F04699-99-D-00 13/9002, PRJY 2003-7251	Southard, Rosa	MCCLN_AR_5047.pdf
14 Oct 2003	Quarterly Inspection Report, Operable Unit (OU) D Cap	Brunner, Paul G.	MCCLN_AR_5016.pdf
28 Oct 2003	Data Gap 33 Aquifer Test Performed at EW-323—Submittal of Raw Data F04699-99-D-001319002, PRJY 2003-7251	Willmeth, Elise / Benedict, Stephanie	MCCLN_AR_5009.pdf
01 Nov 2003	Former McClellan Air Force Base Installation Restoration Program Groundwater Monitoring Program Low-Flow Pump Placement Technical Memorandum Final	URS Group, Inc.	MCCLN_AR_5062.pdf
06 Nov 2003	Quarterly Inspection Report, Operable Unit (OU) D Cap (DSR# 1137-1)	Brunner, Paul G.	MCCLN_AR_5007.pdf
04 Dec 2003	Groundwater Monitoring Program Electronic Submittal of Final Quarterly Report, Second Quarter 2003 McClellan Air Force Base F04699-99-D-001319002 PRJY 2002-725 1	Callen, Brenda / Benedict, Stephanie	MCCLN_AR_5145.pdf
08 Dec 2003	Historical Regional Groundwater Elevations	Brunner, Paul G.	MCCLN_AR_5067.pdf
01 Jan 2004	Final Technical Memorandum On-Base GWOU Phase III VOC Data Gaps Investigation	Scott, John D.	MCCLN_AR_5211.pdf
01 Jan 2004	Final Technical Memorandum On-Base GWOU Phase III VOC Data Gaps Investigation	Scott, John D.	MCCLN_AR_5211.1.pdf
01 Jan 2004	Environmental Action Update, October-December 2003	Brunner, Paul G.	MCCLN_AR_5276.pdf

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01 Jan 2004	A Quarterly Newsletter About Environmental Activities at McClellan January-May 2004	Environmental Action Update	MCCLN_AR_5455.pdf
23 Jan 2004	Quarterly Vadose Zone Monitoring Report, July Through September 2003 (DSR# 618-1), Former McClellan Air Force Base (AFB), Sacramento County	Taylor, James D.	MCCLN_AR_5256.pdf
23 Jan 2004	Creation of New Groundwater Site (CG320)	Brunner, Paul G.	MCCLN_AR_5176.pdf
29 Jan 2004	Contract No. F04699-99-D-0013/9002, PRJY 2002-7251 McClellan Groundwater Treatment Plant Errata to 2002 Effluent Monitoring Data	Callen, Brenda / Beer, Thomas	MCCLN_AR_5178.pdf
19 Feb 2004	Supplemental Groundwater Monitoring Data (Requirement to Submit Monitoring Data)	Brunner, Paul G.	MCCLN_AR_5219.pdf
23 Feb 2004	Soil Vapor Extraction Remedial Action Operations Work Plan/Project Management Plane	Benedict, Stephanie K./ Graff, Paul	MCCLN_AR_5270.pdf
01 Mar 2004	Work Plan for the Destruction of Extraction Well 85 and Removal of Associated Aboveground Piping	URS Group, Inc.	MCCLN_AR_5269.pdf
03 Mar 2004	Final UST Closure Report 3230 Peacekeeper Way (Bldg 209),UST 209A and 209B McClellan, California	Brunner, Paul G.	MCCLN_AR_5272.pdf
04 Mar 2004	Installation Restoration Program Former McClellan Air Force Base Technical Memorandum For Installation of the Base Well 10 Guard Wells Final	Callen, Brenda / Benedict, Stephanie	MCCLN_AR_5266.pdf
12 Mar 2004	Groundwater Monitoring Program Electronic Submittal of Final Quarterly Report, Third Quarter 2003 McClellan Air Force Base F04699-99-D-0013/9002 PRJY 2002-7251	Callen, Brenda / Benedict, Stephanie K.	MCCLN_AR_5237.pdf
18 Mar 2004	Final Work Plan for an Enhanced Anaerobic Bioremediation Pilot Study at Former McClellan Air Force Base, California	Guest, Peter / Griffiths, Daniel / Wolff, Linda McGlochlin	MCCLN_AR_5391.pdf
26 Mar 2004	Groundwater Monitoring Program Submittal of Piezometer Conversion and Monitoring Well Redevelopment Technical Memorandum, McClellan Air Force Base (F04699-99-D-0013/9002 PRJY 2002-725 1)	Callen, Brenda / Benedict, Stephanie K.	MCCLN_AR_5225.pdf
29 Mar 2004	Final Addenda to the Final GWOU Phase III VOC Data Gap Field Sampling Plan	AFRPA	MCCLN_AR_5278.pdf

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12 Apr 2004	Final Time-Critical Removal Action Completion Report for Hexavalent Chromium dated April 2004	Brunner, Paul G.	MCCLN_AR_5406.pdf
20 Apr 2004	Spill Assessment and Prevention Plan	O'Neil, Brian A.	MCCLN_AR_5396.pdf
22 Apr 2004	Final Five-Year Review Report for McClellan	MWH Americas, Inc.	MCCLN_AR_5402.pdf
17 May 2004	Work Plan for the Demonstration of Passive Groundwater Sampling Devices at former McClellan Air Force Base, California	Hicks, John R.	MCCLN_AR_5395.pdf
18 May 2004	Groundwater Monitoring Program Electronic Submittal of Final Quarterly Report, Fourth Quarter 2003 McClellan Air Force Base F04699-99-D-0013/9002 PRJY 2002-7251	Callen, Brenda / Benedict, Stephanie K.	MCCLN_AR_5386.pdf
20 May 2004	Submittal of the Electronic Deliverable for the Updated Standard Operating Procedure for Sampling Groundwater from Monitoring and Extraction Wells (McAFB-013), F04699-99-D-0013/9002, PRJY 2003-7251, CDRL A018	Beer, Thomas / Benedict, Stephanie K.	MCCLN_AR_5388.pdf
21 May 2004	Well Decommissioning Summary Report for 2003	Callen, Brenda / Benedict, Stephanie	MCCLN_AR_5392.pdf
28 May 2004	Soil Vapor Extraction Removal Action Quarterly Vadose Zone Monitoring Report	Graff, Paul / Benedict, Stephanie K.	MCCLN_AR_5490.pdf
01 Jun 2004	Final First Quarter 2004 OU D Quarterly Inspection Report, Former McClellan Air Force Base, California	BEM Systems, Inc.	MCCLN_AR_5464.pdf
14 Jun 2004	Former McClellan Air Force Base Interim Basewide Remedial Investigation Report, Operable Units A, B, C, and G—Group 1 POL/SSG Remedial Investigation Characterization Summaries Addenda for Selected Sites	Titus, Edward R./ Benedict, Stephanie K.	MCCLN_AR_5494.pdf
25 Jun 2004	Final Addendum to the 1999 McClellan Air Force Base Basewide Volatile Organic Compound Feasibility Study (VOC FS)	Brunner, Paul G.	MCCLN_AR_5487.pdf
29 Jun 2004	Proposed Plan for Cleanup of VOCs in Groundwater	Air Force Real Property Agency, McClellan	MCCLN_AR_5672.pdf
30 Jun 2004	Final Field Sampling Plan (FSP) to Collect Groundwater Data Upgradient of MW-463 (DSR# 1087-4)	Brunner, Paul G.	MCCLN_AR_5616.pdf
30 Jun 2004	LRA Initial Parcel Record of Decision #1 (7 Sites) For Soil at PRL S-014, PRL S-033, PRL S-040, SA 003, SA 035, SA 041, SA 091	Brunner, Paul G.	MCCLN_AR_5488.pdf

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01 Jul 2004	Proposed Plan Fact Sheet	Air Force Real Property Agency, McClellan	MCCLN_AR_5463.pdf
03 Aug 2004	Analytical Results from Groundwater Interim Record of Decision (GW ROD) Phase III Extraction Well by Building 700, McClellan	Brunner, Paul G.	MCCLN_AR_5631.pdf
05 Aug 2004	Submittal of the Final 2004 Groundwater Well Installation Field Sampling Plan	Shulters, Jacqueline C./ Benedicts, Stephanie K.	MCCLN_AR_5573.pdf
24 Aug 2004	Basewide Volatile Organic Compound Groundwater Record of Decision (VOC GW ROD) (DSR# 228)	Brunner, Paul G.	MCCLN_AR_5623.pdf
30 Aug 2004	Final Work Plan for the Destruction of Base Well 23, Monitoring Well 394, Extraction Well 233, and Extraction Well 298, and Removal of Associated Aboveground Piping	Benedict, Stephanie K./ Shulters, Jacqueline C.	MCCLN_AR_5619.pdf
01 Oct 2004	Final Underground Storage Tank (UST) Work Plan for Building 614 (DSR# 767-3), Former McClellan AFB, Sacramento County, CA	Brunner, Paul G.	MCCLN_AR_5535.pdf
08 Oct 2004	Basewide Volatile Organic Compound Groundwater Record of Decision (VOC GW ROD) (DSR# 228)	Brunner, Paul G.	MCCLN_AR_5517.pdf
02 Nov 2004	Final GWOU Phase III Environmental Remedial Plan, On-Base Expansion	Scott, John D.	MCCLN_AR_5493.pdf
08 Nov 2004	Draft, Basewide VOC Groundwater Record of Decision (ROD) for Industrial Reuse	Paul Brunner / AFRPA	MCCLN_AR_6138.pdf
12 Nov 2004	Addendum to the Basewide SVE Removal Action Work Plan	Graff, Paul / Benedict, Stephanie K.	MCCLN_AR_5489.pdf
30 Nov 2004	Soil vapor extraction removal action quarterly vadose zone monitoring report for July through September 2004	Graff, Paul	MCCLN_AR_5651.pdf
30 Nov 2004	Soil vapor extraction removal action quarterly vadose zone monitoring report for July through September 2004	Graff, Paul	MCCLN_AR_5651.1.pdf
01 Dec 2004	Former McClellan Air Force Base Installation Restoration Program Groundwater Monitoring Program Work Plan Installation of Replacement Extraction Wells at OU D	Mitretek Systems	MCCLN_AR_5527.pdf
10 Jan 2005	Resolution Of Informal Dispute On Groundwater Operable Unit (GWOU), Final Phase III (On Base) 60% Design, McClellan AFB	Johnson, Kathleen	MCCLN_AR_5800.pdf

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14 Jan 2005	Groundwater Model Simulation of OU D Well Field Containment Scenarios (DSR# 1450-3)	Brunner, Paul G.	MCCLN_AR_5528.pdf
18 Jan 2005	McClellan Groundwater Treatment Plant Semiannual Mass Discharge Report Dated January 2005 (DSR# 1325-1)	Brunner, Paul G.	MCCLN_AR_5530.pdf
25 Jan 2005	Former McClellan Air Force Base Architect-Engineering (A-E) Services Final Project Work Plan—Site-Specific Initial Parcel Feasibility Study #2	Cramer, Andy	MCCLN_AR_5526.pdf
28 Jan 2005	Groundwater Operable Unit Phase III Construction Schedule	Brunner, Paul G.	MCCLN_AR_5541.pdf
28 Jan 2005	Final Groundwater Monitoring Program (GWMP) Quarterly Report, Third Quarter 2004 (DSR# 590-1)	Shulters, Jacqueline / Stephanie Benedict / URS Group, Inc.	MCCLN_AR_5772.1.pdf
28 Jan 2005	Final Groundwater Monitoring Program (GWMP) Quarterly Report, Third Quarter 2004 (DSR# 590-1)	Shulters, Jacqueline / Stephanie Benedict / URS Group, Inc.	MCCLN_AR_5772.2.pdf
31 Jan 2005	Optional and Deleted Wells Rationale	Brunner, Paul G.	MCCLN_AR_5538.pdf
10 Feb 2005	OU B Operations and Maintenance Plan Addendum, Former McClellan Air Force Base, California	Butler, Greg	MCCLN_AR_5554.pdf
10 Feb 2005	US EPA, DTSC And RWQCB Comments On The Draft Basewide VOC Groundwater Record ROD, McClellan AFB, Dated November 2004	Johnson, Kathleen	MCCLN_AR_5816.pdf
11 Feb 2005	Groundwater Monitoring Program Electronic Submittal of Web Ready and Native Files of Final Quarterly Report, Third Quarter 2004, McClellan Air Force Base	Shulters, Jacqueline C./ Benedict, Stephanie K,	MCCLN_AR_5504.pdf
28 Feb 2005	Soil Vapor Extraction Removal Action Quarterly Vadose Zone Monitoring Report for October through December 2004	Graff, Paul	MCCLN_AR_5652.pdf
02 Mar 2005	Annual Inspection Report. Operable Unit (OU) B 1 Cap (DSR# 1598-1)	Csicsery, Sigmund G.	MCCLN_AR_5575.pdf
02 Mar 2005	Annual Inspection Report, Operable Unit (OU) D Cap (DSR# 1599-1)	Csicsery, Sigmund G.	MCCLN_AR_5576.pdf
17 Mar 2005	Draft Final Basewide VOC Groundwater Record of Decision, For Industrial Reuse	Paul Brunner / AFRPA	MCCLN_AR_6137.pdf
22 Mar 2005	Soil Vapor Extraction Remedial Action Operations, Former McClellan AFB	Graff, Paul / Benedict, Stephanie K.	MCCLN_AR_5613.pdf
25 Mar 2005	Final On-Base Groundwater Phase III Implementation Construction Work Plan	Lindstrom, Ray / Benedict, Stephanie K.	MCCLN_AR_5503.pdf

Document Date	Subject or Title	Author / Corporate Affil	File Name
18 Apr 2005	EPA Formal Dispute On Draft Final Basewide VOC Groundwater Record Of Decision For Former McClellan AFB, Dated March 2005	Johnson, Kathleen	MCCLN_AR_5841.pdf
18 Apr 2005	Initiation of Formal Dispute on the Draft Final Basewide Volatile Organic Compound Groundwater Record of Decision	Frederick Moss / EPA Region IX	MCCLN_AR_6038.pdf
22 Apr 2005	Soil Vapor Extraction Remedial Action Operations, Former McClellan AFB	Graff, Paul / Benedict, Stephanie K.	MCCLN_AR_5613.pdf
29 Apr 2005	Final Groundwater Monitoring Program (GWMP), Quarterly Report, Fourth Quarter 2004, (DSR# 591-1)	Shulters, Jacqueline / Stephanie Benedict / URS Group, Inc.	MCCLN_AR_5771.pdf
29 Apr 2005	Final Groundwater Monitoring Program (GWMP), Quarterly Report, Fourth Quarter 2004, (DSR# 591-1)	Shulters, Jacqueline / Stephanie Benedict / URS Group, Inc.	MCCLN_AR_5771.1.pdf
29 Apr 2005	Final Groundwater Monitoring Program (GWMP), Quarterly Report, Fourth Quarter 2004, (DSR# 591-1)	Shulters, Jacqueline / Stephanie Benedict / URS Group, Inc.	MCCLN_AR_5771.2.pdf
12 May 2005	LRA Initial Parcel Feasibility Study #2	Brunner, Paul G.	MCCLN_AR_5660.pdf
13 May 2005	LRA Initial Parcel Feasibility Study #2 Volume 2 of 2	Brunner, Paul G.	MCCLN_AR_5661.pdf
13 May 2005	Groundwater Monitoring Program Electronic Submittal of Web Ready and Native Files of Final Quarterly Report, Fourth Quarter 2004, McClellan Air Force Base	Benedict, Stephanie K./ Shulters, Jacqueline C.	MCCLN_AR_5546.pdf
31 May 2005	Soil Vapor Extraction Removal Action Quarterly Vadose Zone Monitoring Report January through March 2005	Benedict, Stephanie K./ Graff, Paul	MCCLN_AR_5653.pdf
15 Jun 2005	First Quarter 2005 Quarterly Cap Inspection Report for OU D, Final, Former McClellan AFB, California	Tarter, Ed	MCCLN_AR_5581.pdf
29 Jul 2005	Quarterly Groundwater Monitoring Program Report, First Quarter 2005, Final	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6016.pdf
31 Aug 2005	SVE Vadose Zone Quarterly Monitoring Report, April through June 2005	Graff, Paul / Benedict, Stephanie K.	MCCLN_AR_5657.pdf
08 Sep 2005	Resolution of the McClellan AFB VOC Groundwater ROD Dispute	Nastri, Wayne / EPA	MCCLN_AR_5759.pdf
21 Sep 2005	SEC Proposed "Way Forward" for the McClellan AFB, VOC ROD Dispute	Ashworth, Richard / SAF/IEE	MCCLN_AR_5756.pdf
28 Oct 2005	Groundwater Monitoring Program, Quarterly Report, Second Quarter 2005	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6133.pdf

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28 Oct 2005	Groundwater Monitoring Program, Quarterly Report, Second Quarter 2005	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6133.1.pdf
30 Nov 2005	SVE Removal Action Quarterly Vadose Zone Monitoring Report July through Sep 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6022.pdf
30 Nov 2005	SVE Removal Action Quarterly Vadose Zone Monitoring Report July through Sep 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6022.1.pdf
30 Nov 2005	SVE Removal Action Quarterly Vadose Zone Monitoring Report July through Sep 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6022.2.pdf
30 Nov 2005	SVE Removal Action Quarterly Vadose Zone Monitoring Report July through Sep 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6022.3.pdf
26 Jan 2006	Groundwater Monitoring Program, Quarterly Report, Third Quarter 2005	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6134.pdf
02 Mar 2006	SVE Removal Action Quarterly Vadose Zone Monitoring Report Oct through Dec 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6019.pdf
02 Mar 2006	SVE Removal Action Quarterly Vadose Zone Monitoring Report Oct through Dec 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6019.1.pdf
02 Mar 2006	SVE Removal Action Quarterly Vadose Zone Monitoring Report Oct through Dec 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6019.2.pdf
02 Mar 2006	SVE Removal Action Quarterly Vadose Zone Monitoring Report Oct through Dec 2005	Paul Graff / URS Group, Inc	MCCLN_AR_6019.3.pdf
05 Apr 2006	Installation Restoration Program Start 1: Site Evaluations For Applicability of Soil Vapor Extraction (SVE)	Graff, Paul / Benedict, Stephanie K.	MCCLN_AR_5663.pdf
27 Apr 2006	Groundwater Monitoring program, Quarterly Report, Fourth Quarter 2005	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6135.pdf
27 Apr 2006	Groundwater Monitoring program, Quarterly Report, Fourth Quarter 2005	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6135.1.pdf
27 Apr 2006	Groundwater Monitoring program, Quarterly Report, Fourth Quarter 2005	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6135.2.pdf
30 May 2006	SVE Vadose Zone quarterly Monitoring Report, Jan-Mar 2006 (First Quarter 2006)	Paul Graff / URS Corporation	MCCLN_AR_6124.pdf
30 Jun 2006	Three-Dimensional Groundwater Flow and Fate and Transport Model Technical Memorandum	URS	MCCLN_AR_5681.pdf
25 Jul 2006	JTT Remedy Consensus for McClellan AFB VOC ROD Dispute	Cochnauer, Dexter / AFRPA	MCCLN_AR_5680.pdf

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28 Jul 2006	Groundwater Monitoring Program, Quarterly Report, First Quarter 2006	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6136.pdf
28 Jul 2006	Groundwater Monitoring Program, Quarterly Report, First Quarter 2006	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6136.1.pdf
03 Aug 2006	JTT Remedy Consensus for McClellan AFB VOC ROD Dispute	Takata, Keith / EPA	MCCLN_AR_5679.pdf
10 Aug 2006	Response to AF Letter on JTT Remedy Consensus for McClellan AFB VOC ROD Dispute	Landis, Anthony / DTSC	MCCLN_AR_5677.pdf
14 Aug 2006	JTT Remedy Consensus for McClellan AFB VOC ROD Dispute	Vorster, Antonia / RWQCB	MCCLN_AR_5678.pdf
30 Aug 2006	Soil Vapor Extraction Removal Action Quarterly Vadose Zone Monitoring Report April-June 2006	Paul Graff / URS Group, Inc	MCCLN_AR_6119.pdf
26 Oct 2006	Groundwater Monitoring Program, Quarterly Report, Second Quarter 2006	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6132.pdf
26 Oct 2006	Groundwater Monitoring Program, Quarterly Report, Second Quarter 2006	Jacqueline Shulters / URS Group, Inc	MCCLN_AR_6132.1.pdf
30 Nov 2006	O&M Manual Groundwater Monitoring Program Groundwater Treatment Plant and Investigation Cluster 29 Dual-Phase Extraction System, Final (7 Volumes)	URS Group, Inc	MCCLN_AR_6139.pdf